California Energy Commission

Clean Transportation Program

FINAL PROJECT REPORT

Going for Gold: A Blueprint to Catalyze Medium- and Heavy-Duty Charging Infrastructure Investments in the Los Angeles Region Preceding the 2028 Games

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Prepared by: Los Angeles Cleantech Incubator (LACI)

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Jack Symington
Primary Author(s)

Los Angeles Cleantech Incubator
525 S Hewitt St
Los Angeles, CA 90013
(213) 358-6500
laci.org

Agreement Number: ARV 21-038

Esther Odufuwa
Commission Agreement Manager

Elizabeth John
Branch Manager
COMMERCIAL AND INDUSTRIAL ZEV TECHNOLOGIES AND INFRASTRUCTURE BRANCH

Hannon Rasool
Director
FUELS AND TRANSPORTATION

Drew Bohan
Executive Director

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PREFACE

Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007) created the Clean Transportation Program. The statute authorizes the California Energy Commission (CEC) to develop and deploy alternative and renewable fuels and advanced transportation technologies to help attain the state's climate change policies. Assembly Bill 8 (Perea, Chapter 401, Statutes of 2013) reauthorizes the Clean Transportation Program through January 1, 2024, and specifies that the CEC allocate up to $20 million per year (or up to 20 percent of each fiscal year's funds) in funding for hydrogen station development until at least 100 stations are operational.

The Clean Transportation Program has an annual budget of about $100 million and provides financial support for projects that:

- Reduce California's use and dependence on petroleum transportation fuels and increase the use of alternative and renewable fuels and advanced vehicle technologies.
- Produce sustainable alternative and renewable low-carbon fuels in California.
- Expand alternative fueling infrastructure and fueling stations.
- Improve the efficiency, performance and market viability of alternative light-, medium-, and heavy-duty vehicle technologies.
- Expand the alternative fueling infrastructure available to existing fleets, public transit, and transportation corridors.
- Establish workforce-training programs and conduct public outreach on the benefits of alternative transportation fuels and vehicle technologies.

To be eligible for funding under the Clean Transportation Program, a project must be consistent with the CEC's annual Clean Transportation Program Investment Plan Update. The CEC issued GFO 20-601 to develop a blueprint that will identify actions and milestones needed to accelerate the deployment of medium-duty and heavy-duty zero-emission vehicle infrastructure with a holistic and futuristic view of transportation planning. In response to GFO-20-601, the recipient submitted an application which was proposed for funding in the CEC's notice of proposed awards April 8, 2021, and the agreement was executed as ARV 21-038 on December 16, 2021.

ABSTRACT

LACI developed a blueprint to identify zero-emission medium- and heavy-duty (MDHD) transportation infrastructure that can support operations for the 2028 Los Angeles Olympic and Paralympic Games and catalyze faster investments in regional charging infrastructure, targeting strategic locations that can serve the region's needs for the long-term and factor into the transportation needs of LA28 (the non-profit organizing committee of the 2028 Olympic and Paralympic Games).

Following a selection framework that incorporated regional transit and school bus depot plans, charging compatibility, and MDHD duty cycles, the blueprint identifies optimal sites for priority infrastructure. LACI then collected information on mobile and modular charging and energy infrastructure to estimate the potential for off-grid depots. Combining these inputs, LACI analyzed where and how certain duty cycles could operate entirely or partially with battery-electric vehicles. Based on these assessments, LACI produced a list of priority sites and transportation strategies that can provide charging infrastructure for prioritized MDHD routes. This blueprint provides a framework for infrastructure investments that can scale up to meet the region's zero-emission goals by 2028, support LA28's operations, and benefit the region well into the future.

Keywords
Medium- and heavy-duty vehicles, Los Angeles 2028 Olympics, zero-emission transportation, charging infrastructure, battery-electric buses, Transportation Electrification Partnership, Los Angeles Cleantech Incubator, grid integration, transit electrification

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EXECUTIVE SUMMARY

Introduction

As Los Angeles prepares to host the 2028 Olympic and Paralympic Games (Games), we have an opportunity to change transportation paradigms in the region for the long term. Certainly, the 1984 Olympic Games proved to be "groundbreaking for the way Angelenos used the city as a proving ground for new transportation technology solutions" to significantly reduce traffic congestion and smog, including a "built-from-scratch bus rapid transit system." The 2028 Games offers the same potential to "Go for the Gold" and implement enduring improvements to benefit Angelenos and serve as a model for the world.

LACI convened the unprecedented public-private Transportation Electrification Partnership (TEP) to accelerate transportation electrification and zero emissions goods movement by the time the greater LA region welcomes the world to the Games. TEP has set an overall target to reduce GHGs and air pollution by 25% beyond commitments set in 2028 by pursuing aggressive targets for medium- and heavy-duty (MDHD) transportation: 100% of Metro and Los Angeles Department of Transportation (LADOT) buses to be electric; 60% of medium-duty delivery vehicles to be electric; 40% of drayage and short haul trucks to be zero emissions; and installing 95,000 chargers to support transit and goods movement across LA County. These targets further establish a pathway to achieve the 2035 targets recently set by Governor Newsom that extends statewide that previously set targets by Mayors Garcetti and Garcia to have 100% all zero emissions drayage trucks serving the Ports of LA and Long Beach by 2035.

To assist in achieving these targets LACI developed a blueprint to help LA28–the nonprofit, privately funded organizing committee for the Games–identify, assess, and integrate zero emissions MDHD transportation solutions into the Games in the short-term by catalyzing investment in charging infrastructure that will benefit the region before, during and long after the Games. The blueprint does:

- Assess strategic locations and innovative infrastructure options for zero emissions transit and goods movement operations that the Games could utilize.
- Provide a set of recommendations for how regional stakeholders can prioritize charging infrastructure that is needed long-term for LA while also helping to support the Games' zero emissions goals.
- Identify how zero emission options can support the transportation needs of the Games, both for people and goods movement.
- Analyze the MDHD transportation needs of the Games and identify sites where charging infrastructure – as well as supporting solar or storage installation – deployed by regional transit agencies, warehouse owners and other key stakeholders could enable MDHD zero emission vehicles for the Games if installed by 2028, while also facilitating the region's long-term zero emission plans.
- Assess opportunities to utilize innovative temporary mobile or modular charging solutions to support MDHD vehicles during the Games and assess their long-term value for contributing to the region's electrification plans.

LACI prepared and shared the blueprint with LA28, Los Angeles County Metropolitan Transportation Authority (LA Metro) and other regional transit agencies, energy stakeholders, school districts and private fleet operators to gauge capacity to deploy these infrastructure solutions. In doing so, LACI leverages its long-standing municipal, public agency, and industry contacts to identify where stakeholders can invest in lasting infrastructure or business models that not only will demonstrate the region's leadership in zero emission technology, but also will transform the region's transportation archetype long after the Games are over.

Project Overview

LACI's project identified how battery electric vehicles can support the transportation needs of the Games while catalyzing regional investment in MDHD infrastructure to accelerate transformational deployments of zero emission vehicles. LACI's goal was to strategize how regional transit and transportation agencies and fleets can maximize the zero emission options for spectators, media, and athletes throughout the Games. Additionally, LACI analyzed how temporary infrastructure installations could accommodate the duty cycles associated with the surge in transportation demand, as well as the unique route planning the Games will require. By synthesizing LA28's planned transportation needs with regional electrification opportunities, LACI has demonstrated how regional stakeholders can accelerate zero emission deployments in time for the Games. The final blueprint assesses zero emission opportunities at strategic transportation hubs and routes, as well as a set of recommendations for regional stakeholders to utilize the Games to set in motion infrastructure deployments that serve our community mobility needs and state goals for zero emission MDHD vehicle adoption.

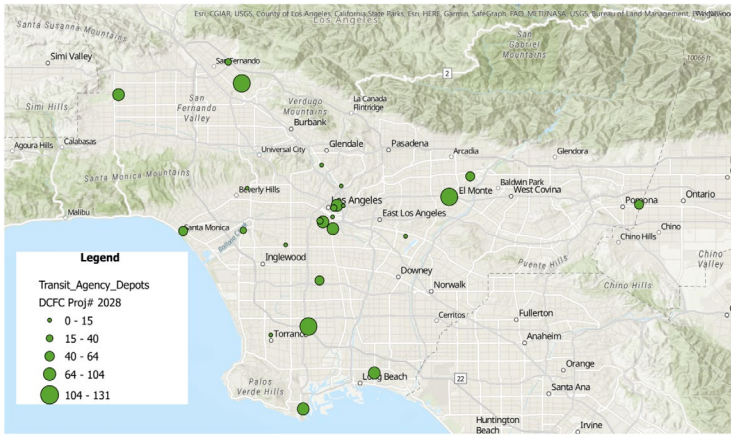
LA28's vision is that no spectators will drive to the Games in personal cars; instead, the Games will prioritize the use of existing public transit, while also supplementing the region's daily transit options by borrowing an estimated 2,700 buses from cities across the nation to transport people to and from competition venues, plus more for the athletes. LA28 will only have the opportunity to request electric buses to serve these needs if there is sufficient charging available at strategic locations throughout the region. Strategizing to maximize the zero emission bus opportunities will require a detailed understanding of how to structure supportive charging infrastructure and technological compatibility by 2028

CHAPTER 1:
Regional Depot Electrification Survey

Overview

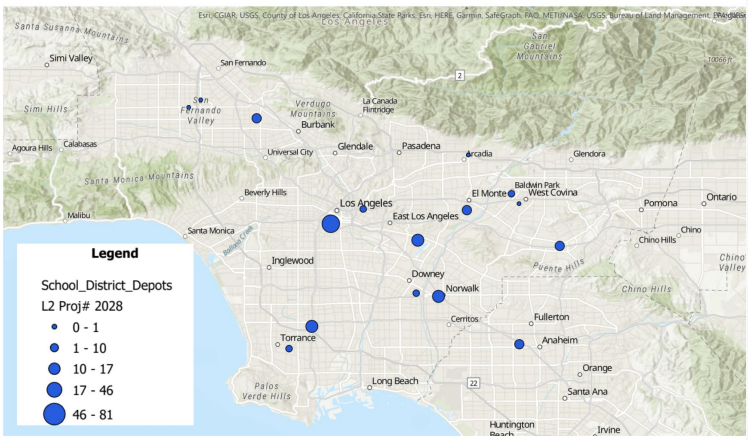
The first step to understanding how to catalyze charging infrastructure deployments that support the 2028 Games' transportation needs while serving long-term needs of the region was to survey key transit agencies and school districts in LA County to identify the locations of their bus charging depots as well as their projected quantity of buses and chargers in 2028. When looking at current plans for charging infrastructure deployments, the total is only 1695 chargers: 1380 DCFC chargers and 315 L2 chargers across the 59 sites (the public transit sites are planning strictly DCFC, while most school districts are planning for almost entirely Level 2 chargers at their depots). Based on this status, the region would need to catalyze a significant investment into charging infrastructure at these facilities to reach the Transportation Electrification Partnership (TEP's) 2028 goals or supplement LA28's operations. Figures 1 and 2 below depict the locations of 59 school and transit depots throughout LA County that currently house buses, as well as their planned electric vehicle supply equipment (EVSE) deployments by 2028.

Figure 1: Map of Planned 2028 EVSE for Transit Agencies



Source: Los Angeles Cleantech Incubator

Figure 2: Map of Planned 2028 EVSE for School District



Source: Los Angeles Cleantech Incubator

Assuming the higher end of fleet estimates (demonstrated in the section **Duty Cycle Analysis**), this would create a need to catalyze investment of an additional 2613 additional charging stations beyond current plans. Deploying these many chargers on such a short timeframe may not be feasible given grid constraints at a particular site. However, as addressed later in **RFI Analysis** there are identified solutions to both increasing the speed to powering up a site, as well as reducing the total amount of power drawn from the grid.

Some other high-level takeaways of our survey of school districts and transit agencies include:

- Transit agencies can have bespoke infrastructure deployments at depots, both in layout and charging forms, so it is important to conduct deep due diligence when assessing potential for supplemental buses to use regional transit infrastructure.
- With the Innovative Clean Transit rule requiring transit agencies to purchase 100% zero emission Buses by 2029, transit infrastructure plans should target full readiness in 2029 or later; catalyzing these deployments to occur prior will require future-proofed construction and immediate grid upgrades.
- While high levels of funding need to continue for deployments, resource-constrained school districts also need operational support from utilities or energy service providers to coordinate infrastructure deployments; and
- State regulations on sales targets, in-use requirements, and rollout plans will help school districts guide timelines for vehicle procurement and infrastructure deployments, and large amounts of available funding at the state and federal level can help school districts maximize zero emission deployments prior to regulatory mandates.

Broadly though, school districts and public transit agencies are great candidates for hosting permanent infrastructure to support the 2028 Games' operations given the overlap in applicable vehicles and the state requirements driving electrification. As a result, the region will need more permanent charging stations to accommodate bus fleets for LA County students and citizens for years to come.

What follows is a summary of the process of collecting this information, the strategy behind fleets' deployment plans, as well as initial assessments of the charging form factors and compatibility.

Transit Agencies

Outreach and Research

LACI surveyed transit agencies with depots geographically spread across the county to evaluate a range of infrastructure options to support the wide distribution of venues. This encompassed the seven largest transit agencies in LA County, plus other smaller operators, providing appropriate scale to the evaluations. In aggregating the information, LACI evaluated the infrastructure deployments at transit agency depots in LA County, both current and projected through 2028, through three methods:

1. reviewing submitted Zero Emission Bus (ZEB) Rollout Plans[1] submitted to the California Air Resources Board (CARB) in compliance with the Innovative Clean Transit (ICT) rule;
2. contacting fleet procurement or operations personnel at the transit agencies; and

[1] https://ww2.arb.ca.gov/our-work/programs/innovative-clean-transit/ict-rollout-plans

3. reviewing announced grant awards from federal and state sources for transit electrification.

The ZEB Rollout plans were submitted by Los Angeles County Metropolitan Transportation Authority (LA Metro) (03/2021), LADOT (10/2020), Long Beach Transit (06/2020), Santa Monica Big Blue Bus (06/2020), Foothill Transit (09/2019), Santa Clarita Transit (06/2020), and Montebello Bus Lines (10/2021). These rollout plans are comprehensive in addressing the timelines and locations for infrastructure and bus deployments across the transit agencies, all in accordance with the ICT's timeline for 100% zero emissions buses in operation by 2040 and 100% zero emission bus purchases starting in 2029.

While complete in scope, some of the rollout plans are up to four years old. As such, LACI followed up with transit agencies where possible to identify if there had been updates to deployment plans since submittals. Either through the contacts listed in the ZEB Rollout Plans or from existing networks, LACI contacted the Santa Monica Big Blue Bus, LA Metro, LADOT, and Culver City (All are TEP partners). In some cases, timelines or sequences had shifted, and, in one case, a transit agency planned an additional entire depot. In Culver City's case, they had not been required by ICT to submit a rollout plan, so LACI received the entirety of its plan from a conversation with its fleet operations team.

Lastly, LACI reviewed the 2022 awards of the Transit and Intercity Rail Capital Program (TIRCP), administered by the California State Transportation Agency to inform this assessment. Some awarded projects aligned with existing ZEB Rollout Plans, in the case of Metro and LADOT, but LACI identified additional ZEB deployments in the TIRCP awards: Glendale Transit and Torrance Transit. Cross-referencing and combining the information from these various sources, LACI compiled the transit agency depot portion of the LA County depot electrification progress and plans.

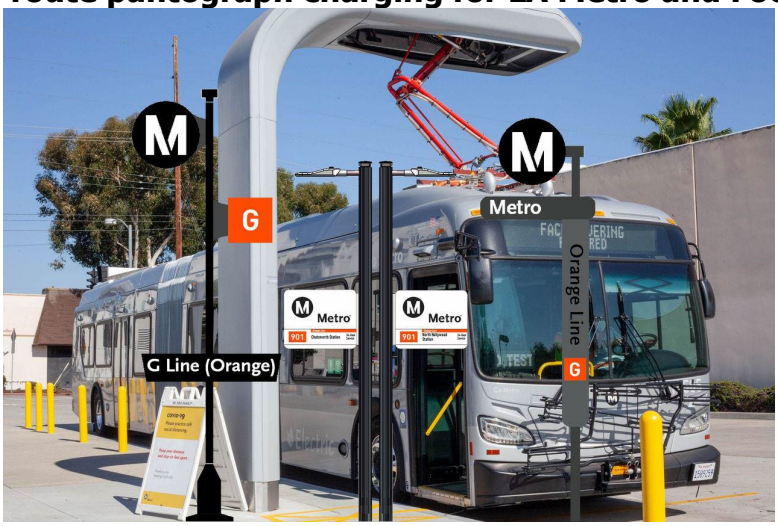
Transit Agency Infrastructure Trends

Transit agency buses operate a more demanding schedule than school buses, so the infrastructure required is significantly more energy-intensive than that for school buses. To begin with, all charging infrastructure installed at the transit agencies surveyed can provide at least 150 kilowatts (kW) to a bus. The battery packs of 35 and 40-foot transit buses are at least 300 kilowatt-hours (kWh), with longer 60-foot buses and double-decker buses holding up to 600 kWh, depending on the model. Transit buses operate all day, typically on longer routes than school buses and often with layover charging or between-shift charging that provides power up to 450 kW. These installations can require a longer construction lead time, given the proximity to sidewalks and streets, as well as a larger upfront capital investment.

Additionally, the charging forms are not consistent across transit agencies. Due to a combination of space constraints at depots and turn-around times for operations, conductive

plug-in charging is not the universal choice. The popular alternative (planned at least by LA Metro and Foothill Transit) is overhead pantograph charging, shown below in Figure 3.

Figure 3: En-route pantograph charging for LA Metro and Foothill Transit



Source: LA Metro

Source: Foothill Transit

Overhead pantograph charging is an attractive proposition for transit fleets, as it avoids taking up space that could otherwise hold a bus. Many transit fleets park their buses 'nose-to-tail' in lanes, where having plug-in conductive chargers to the side or front of buses would be geometrically infeasible. Transit fleets customize these installations to their needs, which would make it difficult to ensure compatibility with unaffiliated buses. An unaffiliated bus would need to not only have an overhead pantograph on its roof, but also have an aligned model that is tested for charging interoperability.

To fund these charging infrastructure installations, many fleets have used Southern California Edison's Charge Ready Transport program, as transit agencies often have long-term control over their facilities, which lends itself to the long-term contractual arrangements of the Charge-Ready Transport Program. Additionally, many of these depots are going to require 10+ MW of peak power, and will be long lead-time infrastructure projects, but this timeline can improve with either smart energy management systems or flexible interconnection to reduce overall power draw or distributed energy resources to flatten the peak demand of the facility.

Individual Transit Agency Deployments and Projections

Table 1 below outlines the current deployments and stated plans of the transit agencies that LACI evaluated. An addendum map shows the geographic locations with graduated symbols to demonstrate the relative size of current and planned deployments.

Table 1: Transit Agency Current and Planned Deployments

Agency	Fleet Size	EV Buses Deployed	EVB Proj. 2028	Line/Division	DCFC Deployed	DCFC Proj. 2028
Culver City	54	4	54		4	27
Foothill Transit	223	17	69	Arcadia	10	50
Foothill Transit	150	18	114	Pomona	10	55
Glendale Transit	37	0	27		0	14
LA Metro	223	20	223	Division 9	10	116
LA Metro	202	10	202	Division 8	10	104
LA Metro	252	20	252	Division 18	0	131
LA Metro	189	0	0	Division 1	5	5
LA Metro	172	0	172	Division 2	0	90
LA Metro	177	0	0	Division 3	0	0
LA Metro	193	0	0	Division 5	0	0
LA Metro	233	0	0	Division 7	0	0
LA Metro	151	0	0	Division 10	0	0
LA Metro	163	0	163	Division 13	0	98
LA Metro	0	0	0	San Pedro Layover	0	100
LA Metro	241	0	241	Division 15	0	124
LADOT	200	5	200	Washington	4	100
LADOT	80	25	80	Commercial	13	40
LADOT	50	0	50	16th & Maple	0	25
LADOT	60	0	60	Sylmar	0	30
LADOT	0	0	100	Watts	0	50
Long Beach	100	34	100		34	100

Montebello	66	0	0		0	0
Santa Clarita	114	0	30		0	30
Santa Monica	195	19	64		25	64
Torrance	63	0	15		0	15

Source: Los Angeles Cleantech Incubator

School Districts

Outreach and Research

The ICT rule does not cover school districts nor is there a parallel rule to regulate the zero emission conversions to school buses (though in 2023, California passed legislation requiring 100% of school bus purchases to be zero emission starting in 2035, with some exceptions). Thus, there was no set of rollout plans collected by CARB from which to reference, nor had any school district published a plan of their own volition, to the best of our knowledge. Therefore, most of the information on school bus deployments, present and future, came from phone conversations or email correspondence with fleet and operations managers or press releases.

Initially, LACI received many contacts from the CEC, from a list of school districts who had received funding for alternative fuel school bus deployment projects by 2020. This contact list yielded discussions with roughly half of the total school districts surveyed. Additional research and outreach leveraged a list of school districts that had deployed or ordered electric school buses by the end of 2021, compiled by the World Resources Institute. Through this process, LACI is confident that our research ultimately accounted for all the relevant major school districts and includes a broad geographic array within the county.

Consistent Infrastructure Trends

Unlike transit agencies, which seem to plan for fewer total chargers than vehicles and maximize an individual charger's utilization by charging multiple buses on the same day, school districts have been installing and planning one charger per one school bus, with some open to extra DCFC in unexpected cases requiring brief downtime for a vehicle.

Following that, school districts have been installing almost entirely Level 2 chargers, given that buses could have ten (or more) hours to charge, and the maximum battery pack sizes of the largest buses are 200-250 kWh, making Level 2 chargers adequate infrastructure for school districts. Level 2 chargers are also substantially less expensive than DCFC, which creates the

ability for school districts to install one charger per bus and not need to rotate charging windows. With lower peak power draws, Level 2 chargers also are less likely to require time-consuming and expensive infrastructure upgrades.

To fund the installation of charging infrastructure, many school districts that are in SCE territory have leveraged the Charge Ready Transport program. The program will pay for the installation of chargers, including all the high-voltage equipment, conduit, and construction; then, the school district will pay a set, predictable electricity rate for a ten-year period. For private entity fleets, this arrangement can be difficult, as it requires approval from the property owner, who may not be the fleet. However, most school districts own their facilities and the parcels, making participating in Charge Ready Transport an attractive infrastructure investment program.

School districts have followed a similar trajectory to other fleets regarding the pace of deployments. As of the end of 2021, many of the school districts surveyed made a pilot deployment of 2-5 buses. After getting a sense of how to manage a deployment of electric school buses, school districts have then planned for a double-digit deployment of buses. Often, school districts have sized these deployments either to address planned retirements of a slate of combustion school buses or fill the remaining electrical capacity at the depot.

Individual District Deployments and Projections

Table 2 below outlines the current deployments and stated plans for the Los Angeles County school districts that have both a) deployed their first units and b) warranted outreach based on location and size. An addendum map showing the geographic locations with graduated symbols displays the relative size of current and planned deployments.

Table 2: School District Current and Planned Deployments

School District	Fleet Size	EV Buses Deployed	EVB Proj. 2028	L2 Chargers Deployed	L2 Proj. 2028
Anaheim Unified High SD	105	12	14	12	16
AVSTA - Antelope Valley	200	7	38	7	30
Arcadia Unified SD	22	1	1	1	1
Baldwin Park USD	28	3	10	5	10
Downey Unified SD	39	3	8	8	8
Los Angeles Unified SD - Sun Valley	193	0	15	0	15
Los Angeles Unified SD - San Julian	364	0	81	0	81
Los Angeles Unified SD - North Hills	33	0	0	0	0
Los Angeles Unified SD - Van Nuys	259	0	0	0	0

Los Angeles Unified SD - Newman Center	39	11	11	10	10
Los Angeles Unified SD - Gardena	360	0	46	0	46
Mountain View Elementary SD	16	5	16	8	16
Montebello Unified SD	95	2	33	2	30
Norwalk-La Mirada Unified SD	74	4	22	11	30
Rowland Unified SD	17	0	17	10	17
Torrance Unified SD	34	0	5	2	5
West Covina Unified SD	21	0	0	0	0

Source: Los Angeles Cleantech Incubator

Specifics will depend on the location and vehicle type, but, overall, charging infrastructure deployments at school districts have a great potential to support a portion of LA28's operations. Using transit agency infrastructure for supplemental buses may be difficult if the transit agencies intend to operate their normal schedule during the 2028 Games, which would require complex sequencing to ensure both the transit agency buses and any supplemental vehicles can all receive the charge needed at the time needed, without considering potential interoperability constraints.

That said, infrastructure and electric bus deployments by transit agencies can still provide electric transportation to many spectators and workforce. For an expansion on the details of the different duty cycles, and the next step in developing specific recommendations, LACI conducted an analysis of the **LA28 Duty Cycles**.

State of Electric Bus Industry

What is critical to the electrification efforts of the multiple LA28 duty cycles is the capacity for manufacturers to produce this quantity of buses, and sufficient demand post-Olympics for other fleets to operate the buses. LA28 anticipates requiring 800 coach buses for the Athletes; a portion of the 4,500-vehicle fleet for the Media and Priority Attendees could be buses (whether coach, transit, school, or airport shuttle), and the 3,000-vehicle supplemental Spectator and Workforce fleet will be entirely buses as well (mostly transit, possibly some school). It is safe to assume that LA28 will require over 4,000 buses for the summer.

For coach buses required for the Athletes' duty cycle, there are few manufacturers of electric versions: a Motor Coach Industries unit, as well as a BYD model, though access to federal funding for the latter is a concern if looking to maximize incentives. Even so, the coach bus industry is not traditionally a high-volume industry; according to the American Bus Association[2], the North American market hit a high in 2017 of 2,279 coach bus sales and that

[2] https://buses.org/wp-content/uploads/2024/05/2023-Coachbuilder-Yearly.pdf

number dropped to 1,245 in 2023. In 2023, NFI (the parent company for MCI and largest manufacturer) only received orders for 550 coach buses in total, of which a small portion was electric. For manufacturers to ramp up to 800 BEV coach buses in the next four years would require a significant escalation of manufacturing capacity for BEV buses, and it is unclear if the demand from traditional coach bus fleets can drive that market. Given the advertised range of the electric coach buses of 200-250 miles, the technology is suitable for LA28's purposes, but some traditional buyers of coach buses may expect longer ranges for their standard trips, dampening manufacturers' incentives to ramp up production in the near-term. One exception could be coach buses that traditionally serve as regional shuttles; one option relevant to Southern California are casino shuttle buses, which traditionally operate point-to-point routes between urban centers and the casino resorts 50-100 miles away. Additionally, coach bus shuttles are already used for professional sports teams, and operators of those charter buses could drive the market for battery-electric coach buses.

For transit buses, the volumes are traditionally higher, with around 5,000 per year[3], a growing portion of which are battery-electric; Calstart estimates that the battery-electric bus market increased 12% between 2022 and 2023, to a total of 6,147 units either deployed or ordered in North America as of September 2023. This number does cover smaller buses that may not be suitable for LA28's purposes though. California alone accounts for 1,946 units with 1,670 being battery electric. Unfortunately, many of these buses are not yet deployed, as infrastructure installations can cause costly delays. From a technology perspective, the current models of battery-electric transit buses, with ranges 150-200 miles, can meet many route requirements for transit agencies, though agencies are also considering fuel-cell electric vehicles as part of their broader asset mix.

To the degree that battery-electric buses can meet the operational needs, managing a procurement of hundreds or thousands of buses for the 2028 Games, units distributed to regional or national transit agencies afterwards, will require close coordination on specifications and design to ensure applicability between the supplemental bus fleet and the agencies' bus fleet. For instance, one likely requirement would be having a manual, plug-in conductive charging port on the vehicles; although some transit agencies are using overhead pantographs, the presence of a plug-in conductive charger (CCS format) will be necessary for LA28 supplemental buses to have the flexibility to use permanent charging infrastructure at school districts or off-grid depots.

Electric school buses are the fastest growing sector of the bus industry, spurred by recent sizable commitments from the State of California and the federal government. This is primarily based on the range-compatible duty cycle, the focus on relieving pollution burdens from students, and the ability to use the school buses as energy assets for Vehicle-Grid Integration (or Vehicle to Load) purposes. To date, there are over 2,200[4] school buses delivered or on

[3] https://transweb.sjsu.edu/sites/default/files/1234-US-transit-bus-mfg-industry.pdf
[4] https://www.wri.org/insights/where-electric-school-buses-us

order, with committed funding in the next year for another 3,500. This growth bodes well for the opportunity for local school districts to move quickly to secure funding and implement projects in the next four years. The ranges of school buses (130-150 miles) are lower than that of transit or coach based on the operational needs - this does reduce the applicability of school buses for LA28's needs, though a bus with that range is still relevant for some mobility shuttle duty cycles. An additional concern would be the loading/unloading time of a school bus (with only one door vs. a two-door transit bus) and the effect this would have on mobility hub schedules.

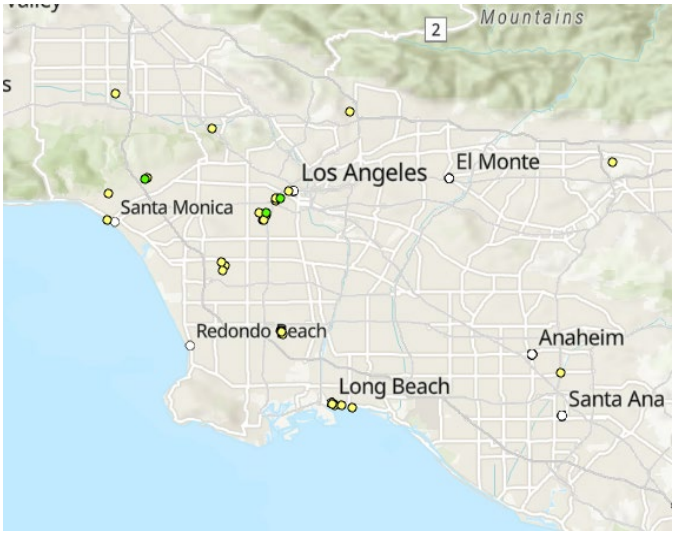
CHAPTER 2:
LA28 Duty Cycles

To further our understanding of the 2028 Games' transportation electrification potential, the project team gathered information on the duty cycles incorporated into its operations. Broadly speaking, a duty cycle refers to the frequency and mileage of routes specific to a certain vehicle or group of vehicles. For LA28, there are four major duty cycle typologies associated with moving personnel and goods throughout LA County during the 2028 Olympic and Paralympic Games, each with nuanced needs regarding vehicle type, quantities, and routes that affect the ability to electrify the duty cycle. The four duty cycles are:

- **Athletes:** Transporting athletes from the Olympic Village to the venues and back.
- **Media/Priority Attendees (MPA):** Transporting members of the media, as well as members of other nations' Olympic Committees, officials, commercial partners, families of athletes, or other priority attendees.
- **Spectators/Workforce (S/W):** Transporting all spectators, as well as the workforce present at venues (i.e., concessions, facility maintenance, security, etc.)
- **LA28 Operations (Operations):** Transporting the equipment needed to produce the 2028 Games from centralized locations to venues or venues to venues; transporting equipment needed for broadcasting in the field; provisions for athletes, etc.

After LACI identified the inputs - locations, trip frequency, hours of operation, and bus volumes required from LA28 to assess the operational requirements, LA28 provided its initial estimates based on internal conversations and discussions with consultants that have Olympics experience. LACI and LA28 note that, though venues and villages are mostly confirmed at this point, there are assumptions baked into the details and the strategies that are subject to change. **Figure 4** below shows LA28 bid venues shown in yellow dots and Olympic villages in green dots.

Figure 4: Locations of LA28 Bid Venues and Villages



Source: Los Angeles Cleantech Incubator

For example, transportation volumes for a specific venue depend on ticket sales and venue capacity; though the latter is a static number, the former is based on assumptions from previous Olympic and Paralympic Games and liable to change. Similarly, the number of Priority Attendees is variable, and, thus, so is the quantity of vehicles required for their transportation. Lastly, the format of the Mobility Hubs is a continuing development based on refined estimates and ongoing mutual planning between LA28, LA Metro, the city and other public sector stakeholders. These assumptions are initial estimates and LA28 will continue to refine estimates for both fleet size and operations as the sport program and event schedule develops. To move forward with timely recommendations for how to electrify transportation during the Olympics, LACI and LA28 have conducted the below analysis to the best of our current understanding.

Each of the analyses below will include: 1) Operational Considerations (including timing, volumes, and vehicle types); 2) Anticipated Distances and Locations; and 3) Takeaways.

Athletes Duty Cycle

The most mission-critical transportation need, LA28, will be transporting athletes through a 'closed-loop' system, where only LA28 and associated contractors (and potentially specific municipal stakeholders for traffic management purposes) have visibility into the scheduling, asset allocation and routing. However, given our knowledge of the venues and villages, we can estimate what potential mileage requirements will look like.

Operational Considerations

While in some cases, a specific bus will exclusively serve a specific team (i.e., each nation's basketball team will have a dedicated coach bus), LA28 will likely deploy buses to different venues on different days - one day may require transportation from the Olympic Village to the South Bay Sports Park, while the next day will require trips to the Valley Sports Park. No given

venue is guaranteed to require transportation every day throughout the two weeks (i.e., a venue that only hosted one event will no longer be relevant after medals in that event are awarded), so any individual bus will likely drive to multiple locations throughout the two weeks. In some cases, a different coach bus from the one that dropped off the athletes may return the athletes to the Olympic Village. This day-to-day variability is almost a certainty and makes specific daily mileage for an individual vehicle difficult to gauge at this point.

There are also two unique factors to the Athletes' duty cycle that affects vehicle choice, and thus, the capacity to electrify the operations. First, the Athletes transportation may rely predominantly on coach buses to accommodate the storage needs for equipment, a form factor with fewer commercially available electric models at this point. Additionally, LA28 must consider its commercial sponsorship strategy, as the 'Official Vehicle Sponsor of the 2028 Games' may provide the vehicles for Athletes' (as well as Media/Priority Attendees) transportation. If not a product of the sponsor, the sponsor is likely to dictate vehicle selection.

Yet, LA28 does not have a full schedule of events outlining the day or the time that any specific event will take place and will not until sufficient time has passed for planning until after the Paris Olympic and Paralympic Games in Summer 2024. This precludes us from knowing hours of driving per day, or length of opportunities for charging. However, LA28 preliminarily anticipates needing approximately 800 buses (again, likely predominantly coach buses) for the Athletes' duty cycle. However, the two firm data points we do have is that these buses will depart from the Olympic Village and their destinations will be one of the venues. This provides an opportunity to examine these specific locations for charging opportunities; there are spaces adjacent to these locations that may have the capacity to stage buses and any associated mobile energy and charging infrastructure.

Anticipated Distances and Locations

The project team's first step was to determine the universe of mileage required for potential routes between the Olympic Village and the venues. Using input from LA28 and publicly available venue designations, LACI created GIS map layers in ArcGIS to establish this network of routes. ArcGIS then has a tool titled 'Network Analysis' that quantifies the distance between any two nodes via the road network, seen in Table 3 and Figure 5 below.

Because UCLA's Westwood campus is guaranteed to serve as the central hub for transportation needs, with all Athlete buses likely stopping at the facility at some point during the day, potentially garaging on-campus or nearby overnight, this simplifies the ArcGIS analysis. If there ever is a desire to plan to move buses from one venue to another before returning to the Olympic Village, LACI and LA28 can readily reconfigure the GIS Network Analysis to accommodate this route.

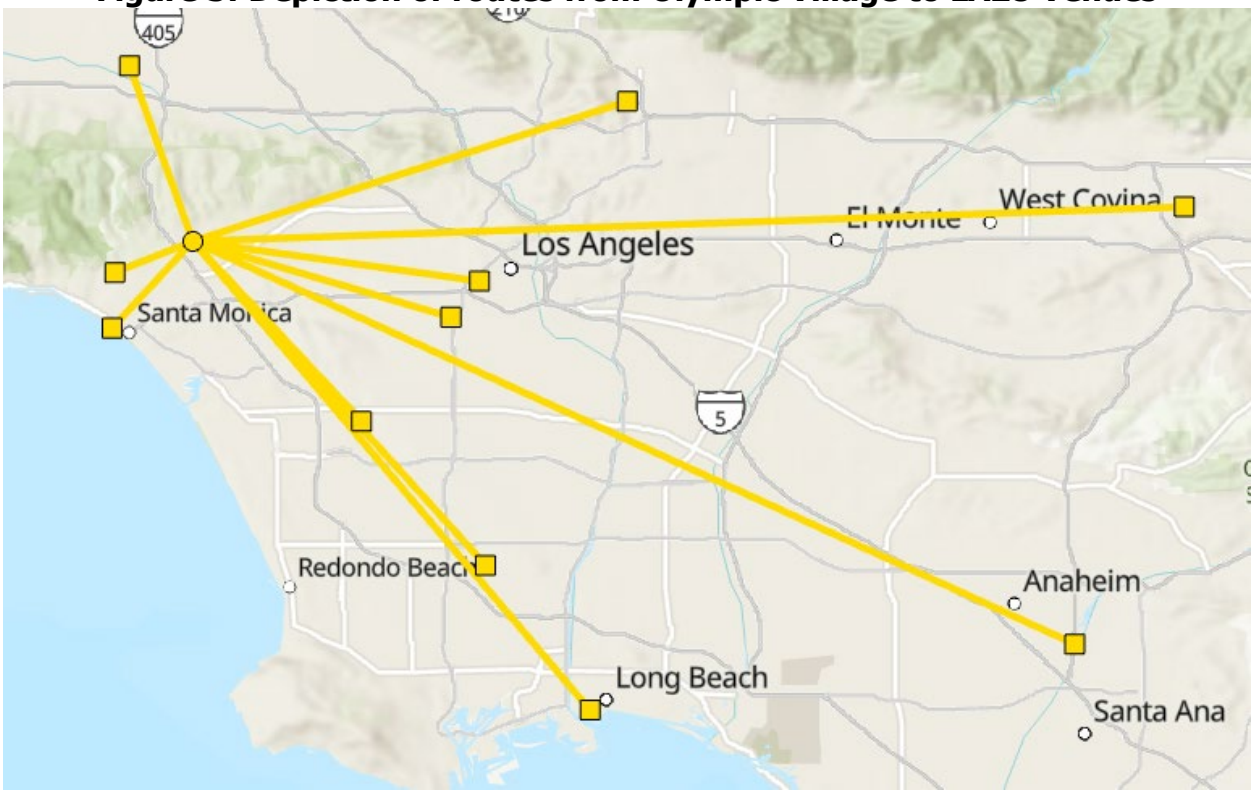
Additionally, the mileage calculated the shortest route option one could take to get from Point A to Point B, without any preferences for freeways or side streets, time of day, or other operational factors. After running the analysis, LACI cross-referenced the route calculation with Google Maps and found the ArcGIS produced distance was consistently within three miles of options proposed by Google Maps.

Table 3: Routes and Distances for Athletes Duty Cycle

Name	Total Miles (One Way)	Total Miles (Round Trip)
Olympic Village - Riviera Country Club	4.57	9.13
Olympic Village - Santa Monica Beach	6.12	12.25
Olympic Village - Valley Sports Park	10.53	21.07
Olympic Village - Inglewood Sports Park	11.63	23.25
Olympic Village - USC Sports Park	11.78	23.56
Olympic Village - Downtown Sports Park	11.81	23.62
Olympic Village - Rose Bowl	21.03	42.06
Olympic Village - South Bay Sports Park	22.16	44.31
Olympic Village - Long Beach Sports Park	30.07	60.14
Olympic Village - Bonelli Park	40.37	80.73
Olympic Village - Honda Center	41.00	82.01

Source: Los Angeles Cleantech Incubator

Figure 5: Depiction of routes from Olympic Village to LA28 Venues



Routes are calculated via streets and freeways, depicted as a straight line
Source: Los Angeles Cleantech Incubator

Takeaways

Though there is great variability in the single-length (i.e., half of a round trip) mileage requirements for the Athletes Duty Cycle – from 5 miles (Riviera Country Club - Golf) to 82 miles (Honda Center - Volleyball), there are opportunities to electrify specific venue routes within this broader duty cycle depending on the asset allocation and operational flexibility required. If buses consistently wait at the same venue until the end of the event for which the bus delivered the athletes, an electric bus can perform many of these routes between the Olympic Village and a venue.

For example, Motor Coach Industries (MCI - a subsidiary of New Flyer Inc) has introduced an electric model coach bus with an estimated 200 miles of range. Even without recharging while waiting at the venue, a coach bus with this range could handle two roundtrips per day to every venue but one, and three round-trips to 75% of the venues. There are similarly many transit and school buses that could handle multiple roundtrips per day for at least half of the Athletes' duty cycles contemplated. Crucial, then, to electrifying large portions of the Athletes' duty cycle would be sufficient space and charging infrastructure at, or a reasonable distance from, UCLA.

Media/Priority Attendees

Over the course of the 2028 Olympic and Paralympic Games, LA28 will be coordinating the transportation for a variety of other stakeholders who require punctual attendance. This includes, but is not limited to, media, International Olympic Committee members, members of other national delegations, and commercial sponsors. Ensuring the electric transportation needs of these Media and Priority Attendees will also require a specific transportation network and strategy.

Operational Considerations

There are multiple similarities between the Media/Priority Attendees' (MPA) Duty Cycle and the Athletes' Duty Cycle. The MPA Duty Cycle will also be a closed-system operation managed by LA28 or dedicated contractors. Additionally, the resulting commercial sponsor is likely to dictate the vehicle selection; however, many MPA vehicles will be smaller passenger vehicles (or vans or shuttles) where manufacturers are providing a wider range of EV selections with longer ranges. LA28 anticipates requiring approximately 4,800 of these vehicles for the MPA Duty Cycle; the exact vehicle mix has not yet been determined. Similarly, vehicle allocation will vary day-to-day (i.e., there is no guarantee that any one vehicle will go consistently or exclusively between the Olympic Hotels/Main Press Center (USC) and a given venue).

Operationally, LA28 will likely require a greater deal of flexibility from these vehicles, including more variability in route selection, less consistent locating of overnight dwell time, and more hours per day of operation than expected by the Athletes' duty cycle. A car that travels from the Main Press Center to South Bay may go to Inglewood next and back to South Bay before returning to the Main Press Center. In general, this operation is less hub and spoke and more point-to-point.

As for timing throughout the 2028 Games or on a specific day, the details are still unknown, and demand will be a factor of MPA transportation needs, which can vary day-to-day. However, it is likely that MPA transportation needs will be constant all day, creating a potentially demanding duty cycle.

Anticipated Distances and Locations

Using an analysis largely like that for the Athletes' Duty Cycle, LACI calculated in ArcGIS the one-way and round-trip distances required by MPA Duty Cycle vehicles. Not included in these calculations were venue-to-venue distances (as frequencies - or existence of demand - are unknown at this time), though existing software can readily accomplish this.

Similarly, to the Athletes' Duty Cycle, LACI calculated mileages in Table 4, and routes depicted in Figure 6 below based on the shortest route option one could take to get from Point A to Point B, without any preferences for freeways or side streets, time of day, or other operational factors. LACI again confirmed accuracy with Google Maps.

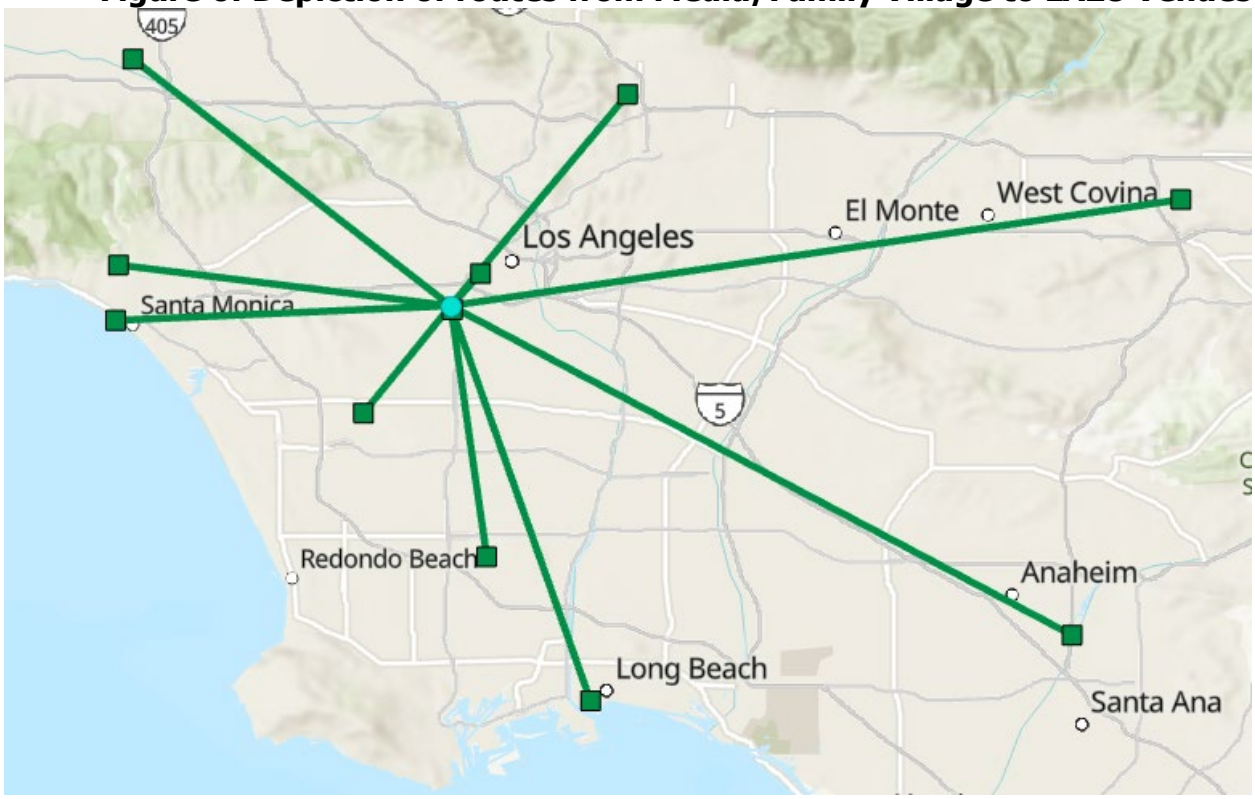
Table 4: Routes and Distances for MPA Duty Cycle

Name	Total Miles (one-way)	Total Miles (round-trip)
Main Press Center - USC Sports Park	0.43	0.87
Main Press Center - Downtown Sports Park	2.07	4.14
Main Press Center - Inglewood Sports Park	8.11	16.22
Main Press Center - South Bay Sports Park	12.59	25.17
Main Press Center - Rose Bowl	13.00	26.00
Main Press Center - Santa Monica Beach	13.73	27.47
Main Press Center - Riviera Country Club	14.42	28.84
Main Press Center - Valley Sports Park	19.89	39.79
Main Press Center - Long Beach Sports Park	20.53	41.06
Main Press Center - Honda Center	29.88	59.76
Main Press Center - Bonelli Park	30.93	61.85

Given the proximity between Media Village and the Olympic Family Hotels, LACI has only conducted one route analysis - round-trip variances between routes beginning at Media Village and routes beginning at the Olympic Family Hotels will be +/- 2-4 miles.

Source: Los Angeles Cleantech Incubator

Figure 6: Depiction of routes from Media/Family Village to LA28 Venues



Routes are calculated via streets and freeways, depicted as a straight line.
Source: Los Angeles Cleantech Incubator

Takeaways

Overall, there is a great opportunity to use EVs across the MPA Duty Cycle, though details of the operation will dictate the proportion of EVs deployable. Similar to the Athletes' Duty Cycle, one-way trips for the MPA Duty Cycles range from 4 to 80 miles, with all but one venue readily electrifiable for multiple round trips per day, given the +200 miles range of commercially available passenger cars. Larger SUVs, vans, and other shuttles can also serve some of these routes if LA28's asset allocation for the MPA Duty Cycle dictates this diversity. Lastly from a technology standpoint, many of these vehicles will suffice with Level 2 overnight charging, which is quicker to deploy at facilities or in a modular form factor.

From a geographic perspective, the proximity of the Main Press Center and the Olympic Priority Attendee Hotels (both close in Downtown LA) will help ensure the needed vehicle for any route can be available, as an adjacent central vehicle pool can serve both sections. Additionally, this stretch of Los Angeles includes car dealerships from most major manufacturers, potentially providing ample opportunity for charging if the dealers prioritize on-site infrastructure installations over the next few years. This location also provides potential for ample staging areas for vehicles underneath parts of the I-110/I-10 interchange.

Spectators/Workforce

LA28, LA Metro, and regional stakeholders view the Olympic and Paralympic Games as an opportunity to demonstrate a transformation of Los Angeles' public transportation system; this includes new Metro lines, such as the K Line, the D Line extension, the Airport Connector Transit Station, and more. For those reasons, as well as venue safety and the desire to reduce traffic congestion, LA28 aims to minimize the need for personal passenger car transportation. All considered, there will be an emphasis in the Spectator/Workforce (S/W) Duty Cycle on using the existing transportation network, complemented with mobility hubs for 'last mile' shuttles.

Operational Considerations

S/W will differ from the other duty cycles, foremost because of a reliance on public transportation, primarily operated by LA Metro.

Additionally, there are two segments to the transit-oriented S/W Duty Cycle: the existing public transportation system that will carry passengers from around the region to the specific venue mobility hubs, and the shuttles that will transport passengers between the mobility hubs and the venues. The S/W 1st Segment will build off of existing transit routes, with small detours or extensions to reach mobility hubs and the buses garaging in the standard Metro Divisions (as identified in Task 2.1) overnight. For the S/W 2nd Segment, LA28 will identify mobility hubs within a certain radius of the venue, at which there will be a shuttle service.

To a degree, there are benefits to this setup; for one, existing transit routes (S/W 1st Segment) can operate under normal traditions at a given baseline capacity throughout the 2028 Games, though there may be capacity increases based on the schedule. Additionally, the mobility hub locations, and thus shuttle routes, will be fixed for each venue.

To meet these transportation needs (both in terms of passenger volumes and service frequencies), LA Metro, with LA28's assistance, currently projects 2,700 additional buses for the S/W 2nd Segment, otherwise referred to as the Supplemental Bus System (SBS). It is likely that Metro and LA28 deploy the SBS at different volumes and frequencies throughout the region based on the final schedule. LA28, in partnership with regional and national transit agencies, aims for the SBS to bring these buses into LA for the 2028 Games - to attract a sufficient scale of BEV buses will require complex coordination discussed in section **Policy Recommendations**.

Anticipated Distances and Locations

Final details of the S/W Duty Cycle are still unconfirmed, though the venues identified in this analysis have a high degree of certainty to host events. Next, for purposes of LA28's operations, the general "Sports Parks' that will host the events are grouped geographically (USC/Expo Park, Downtown, South Bay, Inglewood), with each Sports Park having a shared

mobility hub for all venues within the complex. Specific locations for mobility hubs have yet to be determined, as factors influencing the location will include space for bus staging, proximity to venues and preferred routes, ability to provide unencumbered travel to the venue, potential travel time to venue, and ingress and egress, among others. As part of this Blueprint, LACI has offered potential options based on these factors and conversations with LA28 (**see Venue Specific Operations**).

In **Venue Specific Operations**, LACI used LA Metro route information, translated into ArcGIS[5], to understand which transit routes can serve as the S/W 1st Segment, and identify which Metro Divisions would service those routes. Given the need for the Divisions to electrify according to the long-term needs of Metro, there must be compatibility between Metro's long-term duty cycles and S/W 1st Segment electrification.

The S/W 2nd Segment can allow for more creativity in partial or full electrification, incorporate modular or mobile charging technology, and potentially leverage school district depots or other permanent infrastructure at staging areas. Calculating the anticipated daily distance traveled by these buses that will operate the shuttle between the mobility hub and the venue is necessary for understanding potential solutions. While distance is a factor, frequency of the round-trip shuttle route, determined by length of time to complete one shuttle loop, is the other. The project team explored two round-trip shuttle times and the effect this would have on bus quantities and daily mileage: 35 minutes and 45 minutes, each of which would include a 5-minute layover at pickup and drop off. For distance, LACI started with LA28's rough parameters for the mobility hubs' preferred distance from the venue, though included precise distances of specific hypothetical options.

LA28 estimated bus quantities based on analysis for how quickly they aim to transport all spectators from an event after closing, or 'clearance time.' LA28 has evaluated target clearance times of 120, 90, or 60 minutes based on time of day (spectators usually linger around the venue longer after morning and afternoon events than after evening events), the capacity of the venue, and the load/unload time. Then, contemplating either a 45 minute or 35-minute round trip shuttle created two expected bus quantities for each hub. A tradeoff worth noting for implications of electrification potential is that a shorter travel time will increase each individual bus daily mileage while reducing the total quantity of buses required.

Table 5 below is an analysis of the potential daily mileage of a bus serving each specific S/W 2nd Segment; the mobility hub distance from the venue is an input based on LA28's initial recommendation. Additionally, the hours of operation per day is based on a preliminary understanding of the quantity of events held at any venue while that venue is hosting an event.

[5]https://lacincubator.maps.arcgis.com/apps/mapviewer/index.html?webmap=f7038da2d1b749c89bfb48e9297c56

Table 5: Locations and Potential Daily Distances for S/W 2nd Segment Duty Cycle

Mobility Hub	Dist. from Venue (one way)	Hours per Day	45 min Round Trips per Day	Buses per Day (45 min.)	Distance per Bus per Day (45 Min)	35 Min Round Trips per Day	Distance per Bus per Day (35 min)	Buses per Day (35 min)
Rose Bowl Mobility Hub	9.5	6	8	509	**152**	11	**209**	636
South Bay Mobility Hub	2.5	10	14	374	**70**	18	**90**	467
USC/Expo Park Mobility Hub	11	10	14	327	**308**	18	**396**	409
Inglewood Mobility Hub	5	10	14	172	**140**	18	**180**	215
Riviera Country Club Mobility Hub	5	8	11	155	**110**	14	**140**	194
Long Beach Mobility Hub	7	10	14	128	**196**	18	**252**	160
Valley Mobility Hub	5	6	8	60	**80**	11	**110**	75
Frank G Bonelli Park Mobility Hub	5	6	8	35	**80**	11	**110**	44
Santa Monica Beach Mobility Hub	4	8	11	16	**88**	14	**112**	20
Downtown Los Angeles	0*	0	0	0	**0**	0	**0**	0

***The Downtown Los Angeles Sports Park will be served entirely by transit (i.e., there will only be a S/W 1st Segment, no S/W 2nd Segment).**

Source: Los Angeles Cleantech Incubator

Takeaways

As seen above, there is great variability in the potential distances for buses in the S/W 2nd Segment to travel; individual buses may require upwards of 390 or as few as 70 miles per day. Additionally, the quantity of buses required for any mobility hub varies greatly, which influences the potential for electrification as charging infrastructure (mobile/modular or permanent) requires extra space at a hub that may already be under capacity constraints for staging buses during the day or garaging buses overnight – for perspective, no existing LA Metro Divisions garage more than 250 buses.

S/W 2nd Segment routes that require fewer buses driving fewer miles will be 'low-hanging' fruit to prioritize for electrification; routes with longer daily mileages and more buses will be more difficult - though that is not to preclude the ability to partially electrify that specific S/W 2nd Segment route. Existing electric transit or school bus technology ranges from 150 to 250 miles depending on the model and passenger capacity, which, at least from a miles per day per bus perspective, can address many of the S/W 2nd Segment routes, space, and energy provisioning options notwithstanding.

LA28 Operations Duty Cycle

LA28 Operations Duty Cycle would include the transportation needed to shuttle equipment from storage at warehouses (or the like) to venues, and back to storage or other venues. At this time, the project team has limited information about the transportation needs for LA28's operations; though specific venues are known, LA28 cannot yet commit to 'home-base' locations to serve as repositories for equipment to deliver across the region. Additionally, LA28 may contract out some parts of those operations and have less influence over the vehicle deployment strategies and locations. It is reasonable to expect the transportation needs will be demanding, with consistent needs to replenish supplies and transfer equipment across the region, at all times of day. Locations that LA28 could leverage for its operations include centrally located warehouses or parking lots throughout the County. Vehicles used are likely to include vans, stakebed trucks, box trucks or similar medium duty trucks, all of which are commercially available. Understanding these constraints of technology and operational information, LACI will provide rough location or procurement recommendations for LA28 to consider maximizing the opportunities for electrification of this duty cycle.

The next stage of developing a plan for maximizing electric transportation was to gather information on mobile and modular charging technology that could either increase the speed of infrastructure development at existing depots relevant to LA28's operation, support an off-grid depot (whether mobility hub itself or just the off-site depot for S/W 2nd Segment buses), or provide specialized mobility services where necessary. To do this, LACI launched a RFI titled: Electric Mobility Solutions & Mobile and Modular Charging Technology for LACI's Going for Gold Blueprint.

CHAPTER 3:
Mobile and Modular Energy and Charging RFI: Purpose, Findings, and Analysis

LACI launched an RFI to gather information on mobile and modular charging infrastructure with the goal of assessing the market landscape of existing technologies and business models. Gathering this information was a necessary first step before understanding how the businesses and technology could integrate into LA28 operations. In addition to mobile and modular charging, LACI looked to evaluate non-traditional electric mobility solutions (e.g., electric cargo bikes, electric low-speed shuttles, etc.) and their potential impact for specific needs of large events and contained campus applications (i.e., operations within a singular Sports Park).

LACI, with project partners Gladstein, Neandross, and Associates (GNA) and LA28, developed the scope and details for the RFI. The RFI sought responses from qualified applicants with the goal of informing the Going for Gold Blueprint, but also creating a resource for regional transportation agencies & planners that can incorporate innovative charging solutions into longer-term planning for the region, as LACI and partners seek to foster electric mobility solutions that can bring the greatest impact to the community, economy, and environment of the LA region.

The RFI was hosted on SMApply[6], an application portal to which LACI had previous experience soliciting applications. LACI hosted an informational webinar[7] after releasing the RFI in the Summer of 2023, and then kept the RFI open for responses for approximately eight weeks. Table 6 below shows the list of companies that responded to the RFI. Additionally, LACI provided an opportunity for written questions and answers to address any questions not made during the webinar. Participation in the webinar and submissions to the RFI met LACI's expectations (an overview of participation statistics is in **Appendix A**).

Table 6: List of Companies that Responded to RFI

Freewire Tech	Auve	Moxion Power
StarCharge	Forum Mobility	InCharge Energy
Tritium	Blue Dot	Electreon
Blink Charging	Swobbee	Leading Ahead Energy

[6] http://www.laci.smapply.org/prog/goingforgoldrfi

[7] https://laincubator-org.zoom.us/webinar/register/rec/WN_7YlFrftbSNmJ009GTfYrpQ?meetingId=6cPdGrOPdqaylWi3UDHKDMtqom6XemWCreXr13qx775WFZdVdzu0fNGHlg0CtJoz.ywMZkP8zOHB6T8UZ&playId=&action=play?hasValidToken=false&originRequestUrl=https%3A%2F%2Flaincubator-org.zoom.us%2Frec%2Fshare%2FBTKCsRzQoGfdzlIGjW4lAFzYjGY_fV1Rc6Nt2khclSagMMi7d2aUAh9gQnzBuN1x.IK75S1xLzAQw1Qk1#/registration

SparkCharge	KEM Power	Circuit
bp pulse fleet	Moev, Inc.	ChargePodX
Wayside Energy	Pioneer eMobility	Stak Mobility
VG Mobility	Ampaire	Electric Fish

Source: Los Angeles Cleantech Incubator

High Level Takeaways

The quantity and quality of submissions to the RFI was helpful for LACI's evaluation of the methods of integrating mobile & modular charging, as well as mobility solutions to the Games operations. LACI held follow-up calls with a wide range of the respondents; the companies roughly fell into three buckets: energy storage, mobile charging, and mobility solutions.

Energy Storage

In total, six companies offered relevant battery energy storage systems (BESS) as a specific aspect of their company's solution (including LACI active or alumni companies SparkCharge, Wayside, ElectricFish, and Freewire Technologies, as well as Moxion Power and Pioneer eMobility). Other companies, such as InCharge Energy and Forum Mobility, have the capacity to integrate battery energy storage into their solutions, but would be using a subcontractor's technology in their broader infrastructure deployment, and equipment mobility would not be core to their offering.

This is not the entire universe of mobile/modular BESS companies, though responses are representative of the range of solutions available in the marketplace now, from a technical specification perspective (i.e., size and capabilities). Some come directly integrated into DCFC charging solutions, while some are stand-alone BESS that can power any range of outputs (building load, auxiliary power, or vehicle charging) and serve as a resilient or additive resource. For our study, all responses are relevant in that they can charge MDHD vehicles, either in a completely mobile capacity, where the energy storage and charging ports can meet the vehicles anywhere, or in a temporary capacity at a site that would require a lower-rated interconnection.

When considering storage size, there is a good range of product offerings in the RFI responses. Generally, more mobile solutions (like SparkCharge) have smaller battery sizes (~60 kWh), given that the weight and size of the batteries would hinder the mobility of the system. Alternatively, Moxion's BESS product, which the operator would need to tow by a trailer hitch, comes in a model with 600 kWh. For perspective, this is approximately the capacity of two 35-foot transit buses or four Type D school buses, depending on the models. With the ability to recharge the storage systems from grid or distributed generation overnight, both small and large BESS products can integrate into operations when structured accordingly.

Charging

All the companies that offer a BESS solution can readily integrate charging, and most companies also offer a range of potential outputs, with systems that can accommodate charging capacities up to 180kW per port; generally, the more mobile the solution, the less the power output available or the fewer vehicles any one unit can support. Additionally, operators could modulate these outputs based on the vehicle's ability to receive the charge or an energy management system incorporated into the product that dynamically alters charging speeds based on available power.

From an interoperability standpoint, the RFI results were encouraging, as most responses addressed a range of input voltages (from 208 to 480 3-phase), input frequencies (50-60hz) and output voltages (200-1000V DC). The ability to handle a range of input voltages and frequencies makes for less uncertainty regarding the ability to operate across different functions, whether it be vehicle charging or power generation. Additionally, there is clear uniformity around the charging standard for plug configuration; Combined Charging Standard (CCS) is the default, but most respondent technologies can support through an adapter in the North American Charging Standard (NACS) (developed by Tesla with other automakers pledging to adopt in the next couple years), while other companies made a note that configuring their product for the NACS is part of their near-term product development pipeline.

Mobility Solutions

Pure-play personal mobility solutions (ones not tied to any specific charging/energy solution) included in responses were limited. Circuit's and Auve Tech's responses align well with the goal to identify solutions for contained-campus mobility for shuttling spectators or media around a given space. One major distinction would be that Auve Tech is an autonomous shuttle, while Circuit has employee drivers operating its low-speed EVs. Both selections also have ranges that can manage an entire day of driving, with charging needs that do not require a bespoke solution (i.e., most household outlets or standard Level 1 or 2 vehicle charging are acceptable). Should LA28 require a contained-campus shuttle service, these options provide valid solutions. In addition to the low-speed shuttle responses, the RFI received a response from Swobee, a provider of micro mobility solutions, both e-bike and scooter, as well as the supporting battery swapping infrastructure, which LA28 could deploy for intra-Sports Park mobility.

Infrastructure Providers

Although not explicitly requested, the RFI received four responses from companies that predominantly focus on providing turnkey infrastructure solutions for bus and/or truck depots. Though likely not a service required by LA28, transit agencies or school districts could use these companies to simplify infrastructure costs and timelines.

RFI Analysis - LA28 Duty Cycle Applicability

After thorough review of applications of how these technologies could directly support LA28's operations, LACI reached out to respondents to request more information regarding answers

to questions deemed incomplete or unclear, or if there was a specific question regarding applicability. Additionally, LACI held a meeting with all Going for Gold partners to brief them on the information provided by the respondents and assess hypothetical deployment potential.

This analysis was a research exercise and not an endorsement of any of the firms and/or technologies by LA28 and/or the International Olympic and Paralympic Committees. Nor does the analysis intend to imply or convey any official commercial agreements, relationships, or endorsements of any of the firms and/or technologies listed with LA28 and/or the International Olympic and Paralympic Committees.

Takeaways

Maximizing the amount of electric transportation at the 2028 Games will require leveraging available depots to the greatest extent possible. We previously outlined school districts and transit depots plans to deploy charging infrastructure to support their pending fleet electrification; however, even counting the high end of these plans, the region's depots would need to catalyze an additional 2600 charger installations by 2028 to support LA28's transportation needs, the majority of which would need to occur at school districts or auxiliary sites in the likely event that transit agencies are unable to accommodate supplemental buses at their depots.

To increase the deployments of charging infrastructure on such a short timeline will require solutions that can reduce the required draw from the grid and reduce the interconnection timelines. Additionally, because some of the operations will include shuttles established at mobility hubs or off-grid depots, there is a need to deploy mobile charging and energy solutions to expand the potential for electrified operations.

With the RFI responses in hand, as well as an understanding of LA28's duty cycles, LACI analyzed how some of these technologies can integrate into LA28's transportation operations. There are three primary methods for the RFI technologies to integrate into LA28's operations while supporting regional transportation and business models:

1. **Solutions to reduce power required from the grid, and thus increase the ease and speed of interconnection.** These include energy management services, which can reduce the peak load of a fleet charging depot, and battery-integrated chargers, which can reduce the amount of grid power needed per charger. Both solutions would benefit transit depots and school districts looking to accelerate grid interconnections prior to 2028.
2. **Mobile battery storage to support off-grid depots.** These would provide power to sites without access to grid interconnection that would temporarily house a supplemental fleet. Chargers attached to these BESS units would create a full off-grid charging depot.

3. **Mobile charging units.** These could complement reservation-based (or fleet-managed) charging infrastructure access to ensure that LA28 fleet vehicles that either don't have established depots or will require midday charging can leverage existing public chargers, with a backup plan of on-demand charging that can dispatch directly to a vehicle.

Below are evaluations LACI made regarding ways to integrate certain technologies included in RFI responses into different LA28 transportation operations. Again, this analysis is a research exercise and not an endorsement of any of the firms and/or technologies by LA28 and/or the International Olympic and Paralympic Committees.

Bus Fleets

While both the Athlete and Spectator/Workforce (S/W) Duty Cycles are similar in their use of buses as the primary means of transportation, there are important differences operationally. The Athlete Duty Cycle will utilize primarily coach buses, the dispatch and management of which LA28 will handle internally. The S/W Duty Cycle is expected to utilize transit and school buses, the dispatch and management of which LA Metro is expected to handle in coordination with LA28. However, both operations will require the use of a large quantity of buses, which will require large power draws and energy demand. To address this, LACI analyzed the 2028 Games bus fleets' expected energy demand and space requirements to understand potential options for RFI respondent solutions to integrate into the operations.

Challenge: Energy Demand

One of the largest barriers to solve when considering deploying electric buses or any other EV infrastructure is the amount of energy necessary and the ability of a utility company to energize the infrastructure/site. The 2028 Games may bring approximately 3,600-4,300 buses into the region for transportation needs throughout the competitions. If all these vehicles were electric, it would put significant energy demand on the grid to properly charge these vehicles. In many locations, current grid infrastructure cannot accommodate increasing energy capacity needs without completing expensive and time-consuming upgrades to the current grid. To model just what this power draw and energy demand could be, LACI analyzed the charging needs for the anticipated supplemental bus fleets.

The battery capacity of the buses fitting LA28's needs range between 60 kWh to 738 kWh, with a median of 313 kWh. Assuming this median battery capacity applies to all the buses and considering unmanaged charging capacity assumptions of 100 kW per bus, the simultaneous power demand for the bus fleet could reach 430 MW during overnight charging hours, with total energy consumption of up to 1348 MWh throughout the night. However, as more specific technical information about eligible fleet vehicles becomes available, the project team can adjust these numbers to better match actual needs. Regardless of the details though, the use of optimization software to help manage grid demand more efficiently will provide drastic energy and cost benefits to the operations of any bus fleet.

Although this supplemental bus fleet is not likely to use existing transit bus depots for overnight charging (as the transit fleets will have their own bus fleets to manage - hopefully with energy management software deployed), it is worth evaluating the energy that a comparable depot would require. From information gathered earlier in the project, we know the largest regional transit depot could require at least 13 MW to charge the buses. Currently, the largest planned charging depot in the state will require around 17 MW of energy, and the site operators for this site will have to provide solar panels and other forms of onsite energy generation to account for energy demand. Based on our estimates, supplementary bus fleets at school districts using permanent infrastructure could require up to 10 MW. Under the likely situation where the supplemental buses have access to far fewer MW, charging management software will be necessary to maximize buses in operation, while ensuring the vehicles can receive all energy needed without going over site power limits.

RFI Solutions

RFI Solution 1: Fleet/Charging Management Software

MOEV Inc.[8], a LACI alumni company and respondent to the RFI, offers a comprehensive platform that utilizes AI to address challenges that arise when using EV fleets. The platform assists users in determining the availability and range demand of buses based on assigned routes. MOEV can also provide fleet operations the ability to plan routes using AI that takes into account factors such as battery capacity, daily weather conditions, and terrain to assign a suitable bus to a particular route. The platform can even help determine how to park the buses to avoid blocking each other when leaving. This platform can help reduce much of the work in determining bus routes and charge management strategies and ensure that an LA28 electric bus fleet can meet its duty cycle demands.

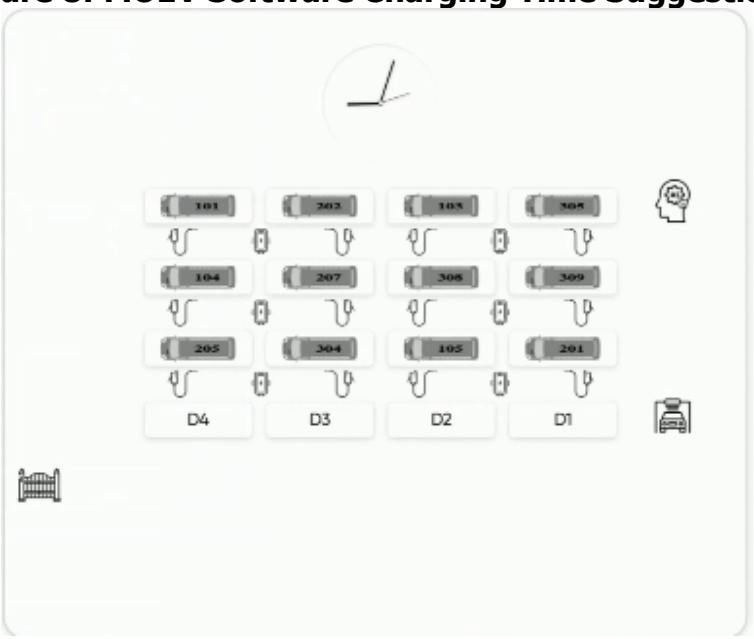
The MOEV platform utilizes real-time telematic data from the buses and any open charge point protocol (OCPP) charger. OCPP is the open-source communication standard for EV charging stations and network software companies so that they can connect to the internet and provide real-time data to transit operators and planners. The platform will also notify you if a bus will not be able to make its previously assigned route based on factors that have changed throughout the night/day and recommend a new bus based on the route needs. Examples of the visualization of this information are in Figure 7 and Figure 8 below.

[8] https://www.moevinc.com/

Figure 7: MOEV Bus Yard Planning Software

Source: MOEV

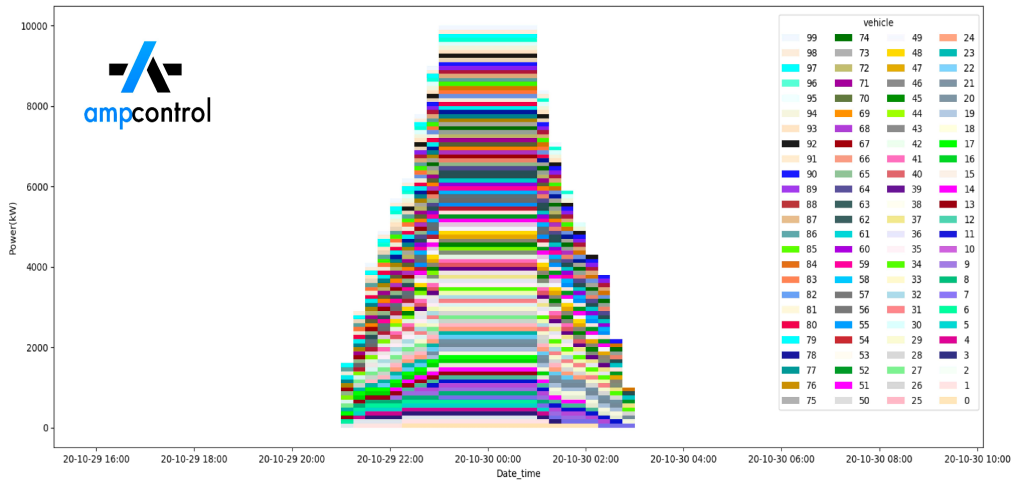
Figure 8: MOEV Software Charging Time Suggestions



Source: MOEV

The MOEV platform is also capable of the grid demand response signaling, and MOEV's user-friendly platform provides imagery to help users best understand the needs of the fleets they are operating. However, in Figure 9 and Figure 10 visualizations from Ampcontrol, another cloud-based energy management software company, helps visualize how operators can use such software for electric buses and charging based on current grid prices or demand.

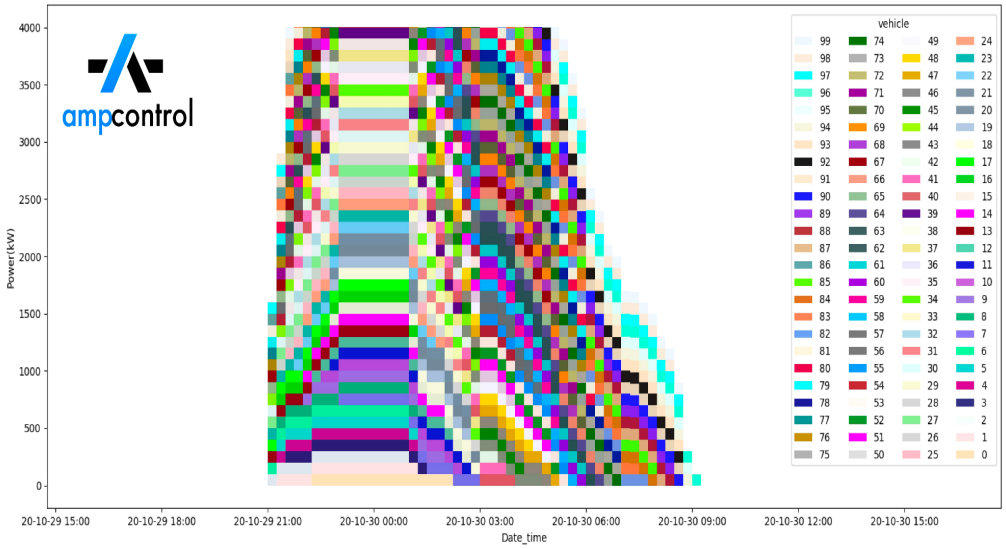
Figure 9: Example of non-peak fleet charging



Source: Ampcontrol

This case study conducted by Ampcontrol visualizes what it would look like if 100 buses were charging overnight at one time. The above figure shows what it would look like for the buses to arrive between 9 PM and 11 PM and all begin to charge at arrival. The assumed maximum power output of each charger is 100 kW, so charging would finish by 3 AM for all the buses. At peak demand, the buses would require 10 MW of energy, a level most sites are unable to provide without lengthy and expensive upgrades.

Figure 10: Example of optimized charging



Source: Ampcontrol

However, when bus charging is staggered, demand for all 100 buses only reaches 4 MW, and the vehicles still get fully charged from 6 to 9 AM, as seen in the above figure. This model creates a dynamic with a lower peak power demand by ~60%.

RFI Solution 2: Rapidly Deployable DCFC

An additional barrier to timely deployments of depot infrastructure can also be the process of installing and interconnecting a sufficient quantity of DCFC. One company respondent to the RFI provides a solution that can both increase the speed with which charging points can deploy and reduce the total draw from the grid, opening possibilities for scaled depots to go from breaking ground to operational in the next four years.

FreeWire Technologies, a LACI alumni company and an RFI respondent, provides a compelling option for fast-charging equipment that reduces grid dependency by integrating storage into the charging unit so operators can quickly deploy or relocate the infrastructure. While this technology could benefit locations more likely to house permanent infrastructure, the Freewire DCFCs can also benefit temporary locations for the supplemental bus depots, with minimal existing electrical infrastructure. It is important to note that this equipment still requires a grid source of power, though only a standard 240V outlet, forgoing the need for heavy construction costs and complex permitting restraints. While standard chargers without battery integration would need full 200 kW of input power to provide 200kW of output power, the Freewire Boost can create 200 kW of output power with only an eighth the amount of input power because of the integrated battery and inverter. This essentially provides an eightfold increase in power delivery for a site under grid constraints.

This equipment also differs from conventional infrastructure in regards to space requirements - while traditional deployments of charging infrastructure can require large transformers and switchgears located at a corner or a site, with power cabinets and dispensers closer to the charging stall, the FreeWire Boost only requires one cabinet at the site of the stall, reducing the need for additional space for supportive equipment.

In the context of the 2028 Games, this technology could support a temporary depot for the supplemental buses (if still able to grid-connect) or a school district depot that has significant grid capacity restrictions at its site. UCLA's campus is also a potential candidate for hosting charging infrastructure, given it will be the location of the Olympic Village. With over 25,000 parking spaces, UCLA has the space to support many vehicles and charging infrastructure. For UCLA's own bus fleet, Freewire's chargers could be an important asset for rapid deployment as well. Facility owners should take into account long-term considerations to ensure that the deployed infrastructure aligns with future electrification efforts beyond 2028.

It is worth noting that the FreeWire Boost is not a true off-grid solution as it still needs to connect to a relatively small amount of input power. Freewire's battery-integrated design enables Boost to connect directly to existing electrical infrastructure, without grid updates and it reduces construction costs and complex permitting. For off-grid solutions, additional RFI respondents provided workable solutions, which operators could potentially use in combination with Freewire.

Challenge: Off-Grid Bus Depot Options

During the 2028 Games, it is likely that transit agencies, including some of the smaller non-LA Metro depots, will need space for their own fleets (some of which will be providing the S/W 1st Segment transit service), precluding their ability for utilization from the supplemental bus fleet.

A likelier scenario for depot availability would be the school district depots in the region; however, even if all area school district depots fully electrified their operations, this would only provide for 2150 charging ports, short of the 4308 supplemental buses potentially needed to deploy. Under the assumptions that 1) transit depots are unavailable to the supplemental bus fleet and 2) all LA County school district depots are available and fully electrified by 2028, there would still be a need for 2,158 charging ports for an all-electric LA28 supplemental bus fleet. Sophisticated operations that allow for 2 buses per charging port could address this shortfall, but that would add a layer of complexity and reduce the margins for error.

This raises the need to consider where the region can station temporary depots that align with LA28's operational needs, to achieve full electrification. Even without pursuing full electrification, there are specific components of LA28's operations that can be electric, but with no sensible place for permanent infrastructure nearby. This raises the possibilities of off-grid charging/energy depots, potentially co-located with planned mobility hubs, that would require a large amount of space and mobile/modular charging infrastructure.

RFI Solution 3: Off-Grid Charging Depot

Several RFI respondents offered solutions that can provide remote, off-grid energy storage systems to charge vehicles or other equipment, such as Pioneer eMobility or Moxion Power. Both entities, through themselves or partners, could provide dispatchable battery energy storage systems (BESS) integrated with charging, with units up to 600 kWh (through product roadmaps from these entities may include units up to 2 MWh). Power output from these units currently are up to 40 kW, though product development strategies may provide up to 150kW power output in the future.

As an example, LACI investigated what amount of infrastructure an electric bus fleet would require for certain mobility hub shuttles. Based on industry efficiency benchmarks, a transit bus requires 2 - 2.5 kWH per mile, while a school bus requires 1.5 - 2 kWh per mile. Therefore, each 600 kWh BESS system could provide 240-300 miles of operation for one transit bus, or 300-400 miles of operation for one school bus. From a space perspective, one acre can accommodate up to 20 buses, 20 charging units and 20 BESS, in addition to the space required for the depots' operations.

Table 7 below shows the amount of BESS units required to fulfill the energy needs of theoretical mobility hub fleets, using data from earlier LA28 Duty Cycle analysis. Given the logistical complexity of deploying an off-grid charging hub with portable storage units (the operator would need enough space for the connected charging units and labor to plug, unplug and transfer units), LACI only evaluated electrification of off-grid charging hubs estimated to need fewer than 100 BESS units. This also assumes the need to have one charger per bus;

however, it is possible that fleets could structure operations with fewer than one charger or BESS unit per bus, thus reducing space required.

Table 7: Sample LA28 Duty Cycle Analysis

Mobility Hub	Buses /Day (max.)	Distance /Day (max)	Total Mileage /Day (max)	Transit Bus Efficiency Range	School Bus Efficiency Range	Total Daily kWh (Transit)	Total Daily kWh (School)	600 kWh BESS Units (Transit)	600 kWh BESS Units (School)
Riviera Country Club Mobility Hub	194	140	27,160	2.0 - 2.5 kWh/mile	1.5 - 2.0 kWh/mile	54,320 - 67,900	40,740 - 54,320	**91-114**	**68-91**
Valley Mobility Hub	75	110	8,250	2.0 - 2.5 kWh/mile	1.5 - 2.0 kWh/mile	16,500 - 20,625	12,375 - 16,500	**28-35**	**21-28**
Frank G Bonelli Park Mobility Hub	44	110	4,840	2.0 - 2.5 kWh/mile	1.5 - 2.0 kWh/mile	9,680- 12,100	7,260- 9680	**17-21**	**13-17**
Santa Monica Beach Mobility Hub	20	112	2,240	2.0 - 2.5 kWh/mile	1.5 - 2.0 kWh/mile	4,480 - 5,600	3,360 - 4,480	**8-10**	**6-8**

Source: Los Angeles Cleantech Incubator

This analysis shows that for some of the mobility hubs with lighter daily mileage requirements, there are technology solutions available, with enough space at the site, to build an off grid charging hub that can provide the energy requirements for a 100% electric bus fleet. Further, if the technology providers develop units up to 2 MWh, the units required would decrease by roughly a third, though space required may stay the same (dimensions of potential 2 MWh are unknown at this time but would be no more than proportionally as large as 600 kWh units). Specific layouts of these sites would also depend on the presence of multi-plug charging cabinets, Level 2 or DCFC chargers, and operational structure (i.e., are operators replenishing BESS units on-site via permanently installed infrastructure or off-site at operators' facility).

The market for mobile BESS units is growing strong, with some companies planning for manufacturing capacities of 7 GWh, per year by 2026, or over 3,500 2MWh units. If LA28 requires a mobility hub (or overnight bus depot) in a location without grid-tied power, these solutions could play a role in providing the charging and energy infrastructure.

Non-Bus Fleets

Challenge: Charging Access

The Media/Priority Attendees (MPA) Duty Cycle, like the Athletes Duty Cycle, will also be a closed-loop system managed exclusively by LA28 or a dedicated contractor. MPA vehicles will include buses, as well as smaller passenger vehicles (or vans or shuttles) providing a wider range of EV selections, with longer ranges. LA28 anticipates requiring approximately 4,200 of these vehicles for the MPA Duty Cycle, though asset mix is yet unknown.

Additional vehicles deployed for shuttling LA28 Operations equipment from storage at warehouses (or the like) to venues, and back to storage or other venues will have a similarly demanding duty cycle, each of which could benefit from both depot and on-demand solutions.

For instance, an operations fleet charging overnight at the same location could benefit from deploying an energy management system to manage power costs (RFI Solution 1). If that site needs to get energized quickly, battery-integrated DCFC can support a more rapid deployment (RFI Solution 2). Under certain circumstances, it's possible that the MPA fleets will need off-grid charging solutions (RFI Solution 3). Exact asset mixes, depot locations, and specific routes will be necessary to understand exact applicability, but the rough parallels exist. However, given the more demanding and complex operations of these duty cycles, it is possible that operators may benefit from on-demand charging outside of a depot (RFI Solution 4). Fleets can use these solutions individually, in combination with each other, or in combination with a depot solution to fit the needs of various duty cycles depending on the vehicle type.

Lastly, there are spectator mobility and charging needs to consider that RFI respondents' technologies and solutions could support. While not directly applicable to LA28's MDHD transportation needs, these responses can support the charging needs of spectators' and workforce's personal vehicles (RFI Solution 5) and can provide last-mile and accessibility mobility needs (RFI Solution 6).

RFI Solution 4: Reserved Parking Spots + Mobile Charging

There are already around 31,000 charging stations in LA County, with more than 100,000 additional chargers planned by 2028. To make this charging more accessible for MPA or Operations vehicles, a partnership with charging companies throughout the County could reserve 5,000 chargers along dedicated routes for these vehicles. This sort of service is a feature of BlueDot, a LACI startup and an RFI respondent that makes locating and paying for public charging easy for fleets through one app. This has the added system-wide benefit of maximizing the utilization of existing charging infrastructure, helping reduce the need for additional charging equipment. Additionally, it can be beneficial to have contracted mobile charging available for these vehicles in the event they need additional charging to account for exceeding miles during their duty cycles.

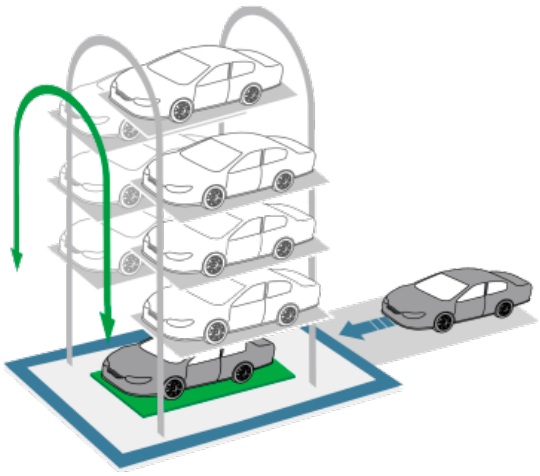
SparkCharge, a LACI alumni company and an RFI respondent, provides this on-the-go charging for vehicles. The SparkCharge Roadie is a portable battery with individual units stacked on each other to increase energy potential and provide charging speeds up to 20kW. Users can summon a charge if stranded away from a charging station or plan to have consistent use at an off-grid location. Having several of these chargers on hand (or a contract with SparkCharge or other operator for the service) could help alleviate range anxiety for the light or medium duty vehicles, though likely a better fit for vehicles with smaller battery packs (passenger cars, SUVs, vans, or other shuttles that may serve many of these routes).

RFI Solution 5: Park and Ride Options

Stak Mobility[9], a LACI startup and an RFI respondent, provides combined parking and charging services and can support the unique people movement and charging at large events or in condensed areas.

Stak offers a space-efficient solution that parks cars vertically, charging them while parked (a rendering is Figure 11 below). This solution could help support LA28's aim to limit the volume of vehicles driving to the events through the deployment of these solutions across a planned network of park-and-rides (possibly at Metrolink stations, or similar) throughout the Los Angeles region. Stak's solution would primarily serve the EV charging needs of light duty passenger cars at these park-and-ride locations, providing a charge while the driver and passengers are transported to Downtown LA via rail or to the venues via mobility hub shuttles. By co-locating this light-duty charging infrastructure at a mobility hub, the energy provisioned to charging a supplemental BEV bus could be part of the broader site development.

Figure 11: Stak Mobility Demo Product Image



Source: Stak Mobility

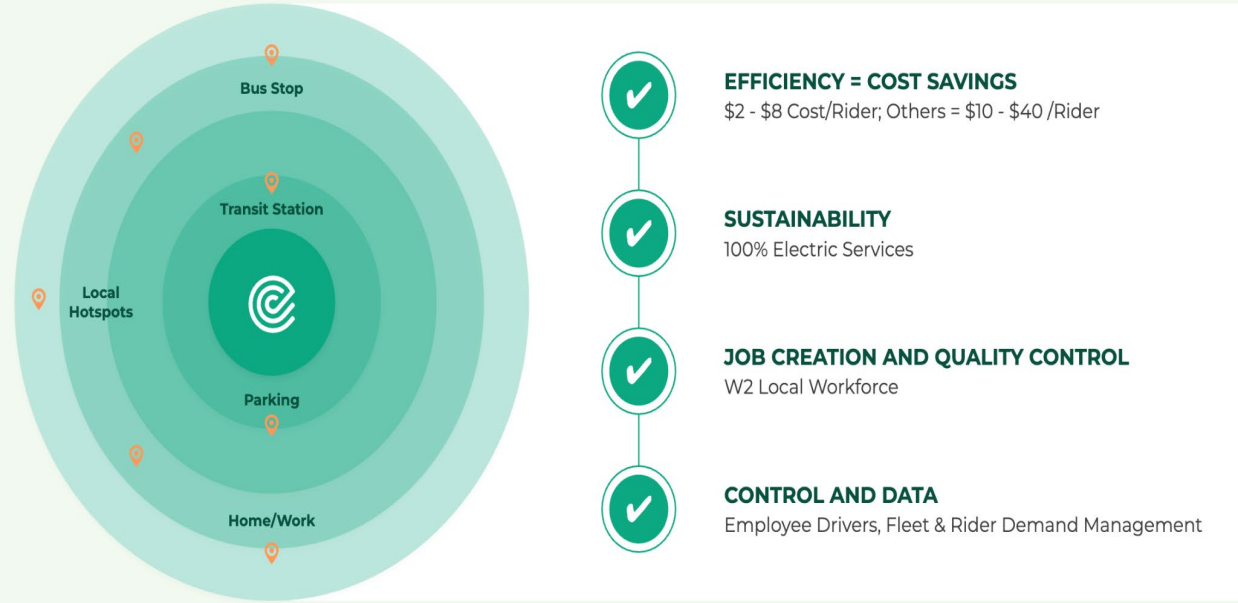
RFI Solution 6: Shared, on-demand, last-mile EV shuttle services

LACI alumni company and RFI respondent, Circuit[10], provides on-demand, last-mile EV shuttle services with experience providing a temporary service for large events. In 2022, they operated branded electric shuttles at Super Bowl LVI at SoFi Stadium in Inglewood in partnership with the NFL. Another RFI Respondent, AuVe Tech OÜ[11], also provides similar light-duty shuttles for short, on-demand routes. AuVE Tech vehicles are autonomous, while Circuit employs W2 drivers to drive its vehicles.

[9] https://www.stakmobility.com/
[10] https://www.ridecircuit.com/
[11] https://auve.tech/

Use of these vehicles along fixed routes or in contained campuses would help reduce congestion moving between venues in a Sports Park or provide a service for any spectators with mobility challenges. This can solve many last-mile and first-mile obstacles, shown in Figure 12 below. Due to Circuit's previous experience with large events, and its commitment to helping these vehicles be low-fare or free (usually ad-supported or under contract with the municipality), this service can serve as a dedicated vendor moving attendees from various locations along specific routes or within a Sports Park. Circuit is vehicle agnostic and allows for the creation of specified geofences to ensure participants who are calling the vehicles are starting and ending within designated areas, making them optimal for moving spectators or other priority attendees around a contained campus.

Figure 12: Circuit's Structural Last-mile Solution



Source: Circuit

CHAPTER 4:
Duty Cycle Electrification Recommendations

To piece together the information about venue locations, duty cycles, transit electrification, and innovative charging solutions into actionable investments and strategies, LACI has put forward options for how each distinct route could maximize electric transportation. From this analysis follows the recommendations on how the region can catalyze certain infrastructure deployments to enable these recommendations to become reality. Below, LACI has offered specific strategies for transit and mobility hub electrification for the spectator/workforce duty cycle as it relates to each venue, as well as strategies for the other three broader categories (Athletes, MPA, Operations).

Spectator/Workforce

Spectator and workforce travel to the Honda Center can leverage good public transit options complemented with mobility hubs to maximize low or no-emission public transit.

Honda Center

Transit

Located in Anaheim, the Honda Center is one of the venues furthest away from the core of Los Angeles, and though there are not any LA Metro bus or rail lines that can transit spectators or workforce to the arena, the Honda Center is conveniently located a short (0.5 mile) walk from the Anaheim Regional Transportation Intermodal Center (ARTIC), which hosts a **Metrolink** rail line that can connect passengers from across the Los Angeles, San Bernardino, Riverside, Ventura, Orange, and even San Diego County, with Union Station in Downtown LA serving as a central transfer point if necessary. Greyhound Bus lines, as well as Orange County Transportation Authority (OCTA) also connect to ARTIC.

Mobility Hub

Projected Daily Energy Consumption (100% Electric): N/A

Currently, LA28 hasn't yet planned for a mobility hub in the area, though the ARTIC, as well as the parking complex surrounding the Angels Stadium have ample space to accommodate a park and ride or mobility hub. Both facilities are close enough to the Honda Center for spectators and workforce to walk the remaining distance, or LA28 to provide short shuttle services on a light-electric vehicle. If required for the mobility hub to be further from the venue, Chapman University and Orange High School have space to serve as mobility hubs for staging last-mile shuttles to the Honda Center.

To electrify these shuttles (irrespective of vehicle type), there is a nearby depot at the **Orange Unified School District**, a school district that has already begun its electrification process but could expand to over 100 Level 2 charging ports. If fully expanded, this facility

would be able to serve the charging needs of enough buses to provide services to any Honda Center mobility hub.

Long Beach Sports Park

Transit

Long Beach will host a range of competitions around the downtown harbor and Convention Center district. Transit connectivity to this district is good, with **Metro A Line** rail and Metro bus lines 232 and 60 both servicing downtown Long Beach (Route 60 operates out of **Division 2**) and maximizing capacity on these networks will be ideal for reducing car traffic and emissions.

Additionally, to the degree **Long Beach Transit**'s routes service the Downtown Long Beach Sports Park and will operate during the 2028 Games, the electrification of that depot (which is partially underway) can provide more electric transportation to spectators and workforce who use public transit or designated shuttles.

Mobility Hub

Projected Energy Consumption (100% Electric): 54-70 MWh

As it stands, LA28 is contemplating the development of a mobility hub for the Long Beach Sports Park, and there are options to either co-locate the charging and energy infrastructure with the mobility hub or separate the two.

Within a reasonable range of the Long Beach Sports Park is the **Long Beach Airport**; though this airport does carry regular commercial passenger traffic, LA28 could use part of the large complex or adjacent parcels as a park and ride and mobility hub for spectators and workforce traveling to the Long Beach Sports Park. If the Long Beach airport is not available for a mobility hub, there still may be an option to use it as an energy hub for overnight charging of buses, likely leveraging the 'Off-Grid Depot' concept, although the Long Beach Airport has known interest in developing its electrical capacity to attract electric aviation transportation. Any development of charging infrastructure could allow for the charging *and* bus staging to occur at the Long Beach Airport.

If Long Beach Airport cannot serve as an energy/charging hub or mobility hub, electrifying the 130-160 buses anticipated for the Long Beach Mobility Hub becomes more challenging. **Cal State Long Beach**, which has a large amount of spectator/workforce parking with space for energy assets, bus charging and staging, while meeting the distance requirements for a contemplated Long Beach Mobility Hub, is the next best option, especially given the likelihood that they will want some degree of permanent charging on their campus eventually, which an off-grid solution can supplement for LA28's purposes.

South Bay Sports Park

Transit

The South Bay Sports Park, located at the Dignity Health Sports Park at Cal State Dominguez Hills, is a dense complex of fields and arenas (and a velodrome). For Spectators and Workforce, existing transit to the facilities is limited, with just a few Metro bus lines servicing the area, only one of which will be from a depot (Division 7) that Metro could electrify by 2028.

However, the **J Line Bus Rapid Transit** (serviced by BEBs) stops at the Harbor Gateway Transit Center, just a few miles from the South Bay Sports Park, connecting passengers to this complex from the San Gabriel Valley to San Pedro. This can be the primary electric transit option; there would still be the need to station a shuttle at this facility, though there is ample space for bus parking/staging. That said, there is unlikely enough space to include energy/charging assets for the entire anticipated supplementary bus fleet at this location.

Mobility Hub

Projected Energy Consumption (100% Electric): 73-94 MWh

The projected quantity of buses for the South Bay Sports Park mobility hub (over 350) makes developing a fully off-grid depot for charging these buses difficult. However, less than three miles away (and adjacent to the Harbor Gateway Transit Center) is the **Los Angeles Unified School District** (LAUSD) **Gardena Bus Yard,** which garages over 300 school buses. This raises the possibility that LA28 could use LAUSD school buses and the charging yard for the South Bay Sports Park Mobility Hub. Charging would likely occur overnight, while the buses transport spectators and workforce from the mobility hub to the Sports Park during the day. This is easily the best option for electrification of this mobility hub fleet.

LAUSD plans as of today do not call for prioritizing the Gardena Bus Yard; this is a perfect example of how the Olympics can catalyze investment in regional charging infrastructure *today* that can accelerate electrification timelines and provide immediate benefits to the community.

Under the assumption that LA28 would prevent parking across the entire CSU-DH campus and the Harbor Gateway Transit Center would not have enough space, there are a few other opportunities for a mobility hub in the desired radius. The first is the **Compton/Woodley Airport**; this airport is primarily for smaller general aviation aircraft operating locally without paying passengers (think of banner planes), and it is unclear to what degree authorities will permit that activity during the 2028 Games. If this activity is curtailed, the space could be used as a mobility hub for the South Bay Sports Park, an energy hub for vehicles deployed in and around the South Bay Sports Park, or even a temporary off-grid depot for part of the supplementary bus fleet, were the LAUSD Gardena Depot to prove infeasible.

Also located close to the South Bay Sports Park is the **Victoria Golf Course**, an 18-hole course owned by the County of Los Angeles. Similarly, to how the Rose Bowl often turns its adjacent golf course into a parking lot for typical games at the Rose Bowl (though not necessarily for this Olympics), the ample space of a regulation golf course can convert into a parking lot with buses staged at the entrance to shuttle passengers to the South Bay Sports

Park. There is even a separate cricket grounds and a driving range, providing plenty of space for parking, bus staging, or even deployment of mobile energy assets.

Downtown/USC Sports Park

Transit

There are many Olympic venues in the condensed area of Downtown LA - Crypto.com Arena, the LA Convention Center, BMO Stadium and USC facilities. Downtown LA is served by multiple rail lines (**A Line, E Line, B Line,** and **J Line)** that can provide transportation to Spectators and Workforce, and bus lines (many operating out of **Division 7**, **Division 13,** or **Division 18**). Additionally, **LADOT** operates plenty of routes across this region, and, based on its plans to 100% electrify its downtown depots by 2028, can also provide electric bus transportation to S/W. This rail and bus access, particularly if Metro Divisions 7 and 18 fully electrify by 2028, offers great options for providing spectators and workforce with electric transportation. However, this may not be enough transportation capacity, and there is still consideration for utilizing a mobility hub to support vehicles driving into the periphery of downtown.

Mobility Hub

Projected Energy Consumption (100% Electric): 283-364 MWh

Well-suited to serve this role of the Downtown/USC mobility hub is **Dodgers Stadium**. Dodgers Stadium has 260 acres of parking spaces to use for bus staging, energy assets, or spectator and workforce parking. From Dodgers Stadium, the USC campus is only six miles away, and any shuttle departing from Dodgers Stadium could stop at the Crypto/Civic Center section en-route to USC. LA28 currently anticipates the Downtown LA supplemental fleet service requiring over 300 buses - this would make converting the entire supplemental fleet for this mobility hub using an off-grid depot challenging, both from a bus procurement and an infrastructure procurement standpoint, as well as space and operational considerations for such an off-grid depot. However, few areas in Los Angeles are as centrally located with enough space as Dodgers Stadium. This strategy also hinges on the LA Dodgers having no home games on its MLB Schedule during the 2028 Games.

If Dodgers Stadium cannot hold energy/charging infrastructure assets, but still will be a mobility hub, LA28 could use the LAUSD San Julian Bus Yard (with space for up to 300 school buses) to provide charging for Supplemental Buses of this mobility hub. The San Julian Bus Yard is another LAUSD facility that is not yet electrified, but the region could prioritize over the next four years, given that accelerating the infrastructure deployment at this facility would provide benefits to the community ahead of schedule and continue providing benefits after 2028. LA28 could potentially even use the LAUSD school buses as a part or a whole of this Supplemental Bus Fleet.

Having transited spectators and workforce from Dodgers Stadium to the Downtown/USC area, buses could travel Figueroa Street to shuttle people between the Downtown LA area to the USC area, and back to Dodgers Stadium. However, this structure to the shuttle service could create too much overlap between the existing LADOT/LA Metro buses and routes. If existing

LADOT/Metro buses operate on their set routes, the electrification of transit mentioned above can ensure that most of this Downtown/USC transportation will be electric. Another option for moving spectators and workforce within a smaller section of the Downtown/USC Sports Park could be the proposed LA Streetcar, which would run in a clockwise loop from Bunker Hill to the Convention Center, primarily on Broadway and Figueroa. Once fully funded and approved, this streetcar could handle a portion of the traffic around the northern half of the Sports Park, connecting to all the downtown LA Metro lines as well.

Both intra-Sports Park transportation options raise the possibility of the Dodgers Stadium shuttle only dropping off spectators and workforce at one central point, with existing transit to take care of the rest.

Rose Bowl

Transit

The Rose Bowl's location and lack of direct transit options makes transportation more reliant on creative solutions. The Rose Bowl typically uses the municipal Brookside Golf Course to provide enough event parking, though Olympic protocols may prevent this setup. Only a few bus lines (two of them Pasadena circulators) come within walking distance of the Rose Bowl, and none garage at priority-electrification Metro Divisions. There is a possibility to encourage S/W to use the **L Line** rail, though that would still require a shuttle service from the nearest stop, the Memorial Park station, three miles away. Given the lack of open space in this area of Pasadena, it is difficult to configure how bus staging for the mobility hub will work. In general, spaces in the radius suggested by LA28, including the Metro L Line stops don't offer traditional park-and-ride capacity and area schools are not large enough to handle the full capacity of passenger vehicle parking and bus staging required.

Mobility Hub

<u>Projected Energy Consumption (100% Electric): 232-299 MWh</u>

Mileage and quantity constraints are a formidable roadblock to deploying BEBs at a Rose Bowl mobility, given the anticipation for over 400 buses potentially driving more than 200 miles each. One of the top options could again be Dodgers Stadium, given its 260 acres of parking spaces.

That acreage includes approximately 16,000 parking spaces; if one forty-foot bus requires five parking spaces (a conservative figure), 400 buses would only require 2,000 parking spaces. If 400 buses require 200 mobile BESS units, and each BESS unit + charger takes up the space of two passenger cars (a conservative figure), that takes the total amount of space required to 2,400 parking spaces out of the 16,000 spaces at Dodgers Stadium to park, charge and deploy enough buses to serve as a park and ride for the Rose Bowl events. This is only 15% of the space at Dodgers Stadium, leaving room for 13,600 parked cars for S/W.

To complement Dodgers Stadium, ample space at the Brookside Golf Course and in the Rose Bowl parking lots could support layover charging as well as bus/energy asset staging, even if closed to spectators. A deployment like this is technically feasible but would rely on capacity for industry to provide the electric buses, as well the opportunity cost of ~%15 of the space at the Dodgers Stadium parking lots. In this regard, elimination round soccer will only occur in the latter half of the schedule, so electric buses used elsewhere in the first half could redeploy to serve the Rose Bowl soccer games.

Inglewood Sports Park

Transit

For S/W transportation to this Sports Park, there are a few different options available. First, by 2028, there will be a direct transit connection between the Inglewood Sports Park and LAX, the Airport Metro Connector Transit Station. Spectators and Workforce from across LA County can arrive here and take a short shuttle to the Inglewood Sports Park, if not directly to the park on the Inglewood Transit Connector if that airport connector can be operational by 2028.

Second, Inglewood Sports Park is in a good position to leverage existing and planned transit electrification. There are multiple LA Metro bus lines that operate along the major thoroughfares bordering the Inglewood Sports Park. Almost all these lines operate out of Division 18, which Metro plans to fully electrify by 2028. It is crucial that this timing does not slip to provide electric transit services to the Inglewood Sports Park. From stops on these bus lines, spectators and workforce would be within walking distance of the venues (though the Inglewood Sports Park is also a good candidate to operate intra-campus mobility solutions).

Mobility Hub

Projected Energy Consumption (100% Electric): 67-87 MWh

As for mobility hub options, if none of the over 10,000 space parking lots surrounding the Inglewood Sports Park will serve as a mobility hub (though some space could still be a rideshare drop off location), there are limited nearby options. Inglewood Unified School District aims to develop a hub for its transportation needs, initially at the current location of Warren Elementary School at 9330 South 8th Avenue, Inglewood CA. This could serve as charging for the mobility hub's supplemental bus fleet, with the available space around Morningside High School, serving as the mobility hub itself. Both are within two miles of the Inglewood Sports Park and could serve as a park and ride and/or mobility hub for at least part of the expected volume. A supportive role in staging buses and/or charging/energy assets could be Hawthorne Municipal Airport. At approximately 1,500,000 sq ft of usable space at the Hawthorne Airport and using our estimates of twenty buses plus BESS & charger per acre, there is enough space to fit all the 200 buses estimated for the mobility shuttle (again, assuming a maximum ratio of one charger and BESS unit per bus), with plenty of space left over for spectators and workforce to park their cars.

Riviera Country Club

Transit

Riviera Country Club is currently estimated to require many Supplemental Buses, due to the somewhat secluded nature of the Riviera Country Club and limited open space nearby. There is one existing Metro transit line, dispatched from Division 7, that passes on Sunset Blvd within a block of the Riviera Country Club that can operate at maximum capacity for transporting spectators and workforce, though it is a circulator route that would only operate between the UCLA campus and the Santa Monica. Likely, there will need to be a mobility hub in the area to meet the full transportation needs; given an anticipated need for 150-200 buses, a sizable plot is needed.

Mobility Hub

Projected Energy Consumption (100% Electric): 47-61 MWh

An ideal option would be the Santa Monica Airport. This location is within six miles of Riviera Country Club, with plenty of open space (>1.5M sqft) to station mobile energy & charging assets and stage buses, as well as provide parking for spectators and workforce before taking the shuttle to Riviera. Fortuitously, Santa Monica Airport is scheduled to cease all aviation activity at the end of 2028; this means, likely, the facility will have wound down much aviation activity by the summer of 2028, making the space a perfect option for a supplemental bus fleet depot. The degree to which these assets can use grid-tied charging infrastructure will require input from the City of Santa Monica to determine to what degree permanent charging infrastructure supports the long-term plans for the facility. The only other possibility for an off-grid depot or a mobility hub in a reasonable radius is the Santa Monica Community College (located adjacent to an E Line Metro stop), but space may still be a constraint at the higher end of supplemental bus fleet estimates.

Santa Monica Beach

Transit

Santa Monica Beach is conveniently located within walking distance of the E Line train. Also, the City of Santa Monica has begun deploying battery-electric buses that could provide BEV mobility to visitors to tour Santa Monica or travel from various points on the westside of Los Angeles to the venue. Continued investment in building out the Santa Monica Big Blue Bus depot can ensure that these transit operations are 100% electric by 2028. Culver City Bus is also rapidly electrifying and has one route that could bring visitors staying in Culver City to Venice Beach, relatively close to the venue for those who want to take in sites of the Pacific on a longer walk to the venue.

Mobility Hub

Projected Energy Consumption (100% Electric): 3-5 MWh

This is one of the smaller venues at the Olympics, with only up to 20 supplementary buses anticipated to meet the spectator and workforce needs. As such, this shuttle depot could use the Santa Monica Malibu USD as a point for charging overnight, regardless of where in the surrounding area the physical mobility hub is located (possibly the Santa Monica Airport) charging point for overnight operations. Given the size of the complex, LA28 would require

minimal additional investment to have the airport mobility hub support both the Santa Monica Beach and the Riviera Country Club.

Valley Sports Park

Transit

Electric transit to the Sepulveda Basin benefits from the previous investment in an electric BRT Line, the G Line, that crosses through the San Fernando Valley, from North Hollywood (where it connects to the B Line from Downtown LA) to Chatsworth at the north edge of the San Fernando Valley, using an old rail track path for the portion passing the Sepulveda Basin. There are also traditional bus lines that pass adjacent to the Sports Park, all of which operate out of Division 8, which Metro plans to electrify before 2028. Thus, any spectators or workforce taking transit directly to the Valley Sports Park will be on electric transit.

Mobility Hub

Projected Energy Consumption (100% Electric): 14-18 MWh

Space exists at the edges of the Valley Sports Park that could support visitor parking and bus staging for a mobility hub and rideshare drop off. With an estimated 75 buses needed for the Valley Sports Park, there is enough space on the eastern or northwestern portions of the Sports Park to stage an off-grid depot. However, catalyzing an infrastructure deployment at the LAUSD Sun Valley Depot would be a great initiative for the region. In fact, LAUSD has already announced its plans to install chargers for 180 buses by 2026. Using this as the charging hub for the buses, before stationing them on the edges of the Sports Park or elsewhere, would be a great opportunity to use existing regional infrastructure to electrify LA28's operations. There would even be the possibility that the schools' buses themselves could be part of the supplemental bus fleet.

Bonelli Park

Transit

On the eastern edge of LA County, Bonelli Park will host events throughout the 2028 Games; though relatively geographically separate from the rest of the venues, that does not affect its opportunities to support electric transportation. As far as local, schedule-routed public transit, Foothill Transit operates throughout the region (specifically lines 197 and 492) and has made great strides on its zero-emission transition–Foothill Transit currently anticipates reaching 50% zero emission adoption by 2028. Additionally, Metrolink serves the area with stops in Covina and La Verne as well, where supplemental buses or rideshare can provide the last mile of transportation.

Mobility Hub

Projected Energy Consumption (100% Electric): 8-10 MWh

Currently, LA28 anticipates a smaller number of supplemental buses for the Bonelli Park mobility hub, possibly given the limited quantity of mountain biking events in the area. Regional charging infrastructure to catalyze for this supplemental bus fleet could be at either of the closest school district depots - Azusa USD and Covina USD depots–which, between both

facilities, could support charging for the expected 35 buses needed. This shuttle service could occur from the nearby transit or Metrolink stops, or even a parking lot on the edges of the Bonelli Park recreation area. If LA28 requires more buses or charging infrastructure than anticipated, Brackett Field, another regional airport, is next door, with space and capacity likely available to support supplemental bus staging or charging needs. Because the anticipated Bonelli Mobility Hub anticipates fewer buses than others, LA28 can be nimble with its approach to providing an electric mobility hub.

Other Resources

Metrolink

Given the locations of the venues, Metrolink, a TEP Partner, will have the primary role of bringing spectators and workforce from across Southern California into Union Station for events occurring in the Downtown LA/USC Core, or transferring through Union Station on the other Metro rail network (with exceptions of the Honda Center and Bonelli Park). However, because of Metrolink's structural emphasis on connecting Ventura, San Diego, San Bernardino, Orange, and Riverside County residents with the core of Los Angeles, there is a great opportunity to maximize Metrolink's capacity for bringing workforce living, and spectators lodging, outside of the core of LA County into the region without adding to traffic congestion. Metrolink trains, though not yet zero emissions, run on 100% renewable fuels with a much lower emission profile.

From an electrification perspective, Metrolink can ensure it provides adequate charging for those utilizing Metrolink park and rides by installing Level 2 chargers across these stations where space permits. An option where space constrains the ability to offer enough charging spaces for the anticipated volume is the Stak Mobility solution, a response provided through the Going for Gold RFI. Note: Metrolink does not have authority over these park and rides - that rests with the local municipality in which the station resides.

Rideshare

Though LA28 wants to reduce the amount of car travel, rideshare will have an inevitable presence, having proved itself an indispensable resource for urban mobility. California has required rideshare companies to have 100% of miles driven on their platforms be zero emission by 2030, and TEP's Zero Emission Roadmap target is to reach 100% by 2028. LACI and regional stakeholders are planning for large quantities of DCFC by the airports to support this transition and alleviate the range anxiety or charging availability that rideshare drivers often cite as barriers to EV adoption. Specific to LA28, it is likely that rideshare drivers use the mobility hubs as pickup/drop off points, so the implementation of EV solutions at the hubs is a priority for maximizing electric transportation.

Athletes

As illustrated in the earlier duty cycle analysis segment, the Athletes' routing has opportunities to electrify based on mileage and usage frequencies, but there are challenges regarding the

space requirements for the approximately 800 coach buses, and the availability of manufacturers to produce that quantity. To accomplish any proportion of the electrification of the Athletes' coach buses, infrastructure in and around the **UCLA** campus will need to play a role.

UCLA will serve a critical role in supporting the 2028 Games, as a hub and waypoint for LA28 operations and a home for athletes. UCLA has already made investments to maximize zero emissions infrastructure capacity for its own operations prior to 2028, including onsite power generation to supplement grid connectivity, which could unlock many transportation electrification options. The UCLA bus fleet is not large though (fewer than 20) so it is not reasonable to install permanent infrastructure that would support all the coach buses needed by LA28. But as LA28 could deploy many different electric vehicles out of UCLA (on Operations), UCLA has an opportunity to accelerate the transition of their bus fleet to battery electric early, while supporting the 2028 Games with charging infrastructure they could use flexibly for a range of smaller form vehicles.

If considering an Off-Grid Depot for the coach buses, LA28 would require approximately 750,000 sqft. Space on-campus is limited outside of the UCLA sports fields themselves - though those are likely going to serve as a training resource for the athletes. UCLA has approximately 23,000 parking spaces on campus that LA28 can use to stage a variety of vehicles. Though the proportion that are in covered garages would be unrealistic for coach bus staging, there is still, again, a good opportunity to stage smaller form EVs operating on the MPA or LA28 Operations duty cycles in these spots, if UCLA installs charging infrastructure throughout the parking structures.

Backed up against the canyons and mountains that divide the San Fernando valley and the lower basin, there are not many suitable locations immediately adjacent to the UCLA Campus, nor are there any school district depots with more than 20 buses within 15 miles. However, just west of I-405, a few miles from campus, there are open spaces on or adjacent to the VA campus (Macarthur Field) that could hold the necessary quantity of Athletes buses with supporting charging and energy assets. Further afield, there is plenty of space around the Sepulveda Recreation area to stage any buses needed for the Valley Sports Park, though constantly traveling across the Sepulveda Pass to begin a route at UCLA would reduce the available range and, thus, the daily available usage of the coach buses.

Long-shot opportunities include the private country clubs golf courses (Hillcrest and Los Angeles Country Club), as well as a municipal course (Rancho Park) that could serve as a staging area for the necessary quantity of buses, though this arrangement is likely to face scrutiny.

If LA28 deploys electric coach buses for the Athletes, ensuring the fleet manager has the tools for visibility in the state of charge of all buses and charger availability will be necessary for

ensuring efficient allocation of the charging and energy assets and matching of the buses to routes.

Media/Priority Attendees

While the Downtown area is the primary nexus for lodging for media and priority attendees (MPA), the Inglewood Sports Park will also likely serve a role in media production, and transportation between these locations could be a fixture of the routing. For all aspects of the MPA duty cycle though, flexibility across the system will be key, given the undefined nature of the duty cycle. Overall, LA28 will work with a contracted fleet management provider, who can integrate different functions to leverage existing, or pending passenger vehicle charging infrastructure.

A third-party with a fleet management system will have a similar need for an energy management system to that recommended for the Athletes. An additional layer that would improve flexibility and access would be including visibility to LA County's public charging network, slated to be over 2,000 DCFC strong by 2028. A system like BlueDot's or Chargeway, that allows for visibility into the availability of public chargers would greatly expand the charging network at the fleet's disposal. Being able to identify chargers accessible during a half-hour between routes in any corner of LA will increase the utilization of the entire network and relieve the need for a concentrated depot to support the 4,800-vehicle fleet.

Concentrated depots will still be necessary and should be where the vehicles are parked overnight. Given the scale of vehicles used, this would require an 'all of the above' approach, both in terms of types of locations and types of chargers (L2 or DCFC). One option for related depots stationed across the country would be **car dealerships** There are multiple condensed blocks that contain many car dealerships (Brand Blvd in Glendale, Figueroa St. in DTLA, Van Nuys Blvd by Sherman Oaks), spread throughout the County, creating a compelling network of both dispatch and charging. It remains to be seen how commercial sponsorship constrains the vehicle choices for the MPA fleet, and how that could affect the availability of competitor's dealerships.

Other options for central depots for staging the MPA fleet would be parking garages, which have continued to invest in L2 and DCFC infrastructure as BEV adoption continues. Municipalities have also invested heavily in charging infrastructure at public facilities across the County. **Los Angeles County** recently won a CEC award to deploy 300 L2 chargers across five different sites in east Los Angeles; an agreement to use some or all this infrastructure would provide a sizable chunk of charging infrastructure for the MPA fleet. Surface lots across **USC**, **LATCC**, **LACC**, **Santa Monica College** would also work for LA28's needs while supporting the transition to EVs for students and faculty. In general, catalyzing large deployments of L2 charging across surface lots or parking garages can provide options for maximizing the electrification of the 4,500 vehicles expected for the MPA fleet.

Another option can be car rental agencies, specifically around the Los Angeles International Airport; these can be a resource for the MPA fleet, especially if there is a formal agreement between LA28 and one or more brands of car rental agencies

Lastly, if the permanently installed infrastructure is not accessible enough for the MPA duty cycle, any of the large undeveloped spaces reference earlier in S/W mobility hub analysis could serve as off-grid depots for MPA vehicles with their affiliated charging + energy assets (assuming they are not used for mobility hubs, or there is sufficient space for both). This includes the Sepulveda Recreation Area, Macarthur Field, Bonelli Park, CSU Long Beach or CSU Dominguez Hills, parking lots of the Inglewood Sports Park, Victoria Golf Course, Brookside Golf Course, or municipal airports (Brackett, Woodley, Whiteman, Hawthorne). This would provide an appropriate geographic dispersion of the MPA fleets to cover the diverse routing needs.

LA28 Operations

As of this writing, the LA28 Operations duty cycle has the fewest details; much of the work of executing the production of the Olympics is only refined after the previous Olympics completes. This applies to the quantity and types of vehicles, but also the distribution locations or repositories LA28 equipment and supplies. Given that the venues and villages (certain nodes of the network) are known, and with an assumption that LA28 will aim to centralize the distribution locations and repositories to the greatest degree possible, it is still possible at this time to estimate a range of foreseeable round trips.

It's likely that the distribution of possible routes mirrors a combination of the Athletes duty cycle (moving from one location to a venue and back, generally more predictable, and easier to electrify) with the MPA duty cycle (moving consistently from venue to venue throughout the day, generally less predictable and more difficult to electrify). Given the current state of MDHD technology though, LA28 could electrify even the more demanding of these operations, so long as there is consistently available overnight charging for the trucks.

Consider a hypothetical day for a Class 6 box truck that leaves a warehouse in Long Beach in the morning, drives to the Downtown Sports Park, repositions equipment from there to the South Bay Sports Park, picks up more equipment there to transition to the Valley Sports Park, before finishing the evening back in Long Beach. That is a busy day that includes a leg from the two furthest apart venues (not including the Honda Center or Bonelli Park). This day is only 115 miles of driving though, well within the range of the Daimler eM2 Class 6 truck (180-250 miles). Both larger and smaller vehicles could perform this route as well, as the Ford Class 3 eTransit's (140–160-mile range) and the Volvo Class 8 VNR (250–275-mile range) both cover this hypothetical operation with buffers to spare. Though there is built-in variability in both structures, a majority of LA28 operational routes will likely be compatible with electric vehicles; the question then becomes where and how much charging infrastructure is needed to support these operations.

One intriguing option for LA28 Operations to catalyze permanent charging infrastructure across the County that LA28 could use would be school district depots. In cases where the utilization of a school district depot for mobility hub shuttles is not feasible (or not preferred based on another mobility hub option), school district depots can serve as an overnight charging option for smaller form LA28 Operations vehicles. Given the prevalence of L2 chargers at school districts, this is not likely a solution for Class 8 tractors but would readily support overnight charging (6-8 hours) for Class 3-6 vans, work trucks and box trucks. Given the broad geographic dispersion of school district depots throughout the County, a comprehensive arrangement, perhaps coordinated by the LA County Office of Education, can provide the perfect mix of charging capacity and flexibility for the fleet.

Though any school district could serve this purpose, the eastern half of LA County has more distinct school districts with their own yards that could support 20-50 chargers each by 2028 if investment is made today. Though smaller than the LAUSD yards, this makes a timeline deployment of infrastructure more manageable, especially if integrating any of the depot solutions outlined in the Going for Gold RFI. While these facilities are possibly an opportunity to store equipment as well, that is not a prerequisite for feasibility given that the trucks would be relatively close (<15 miles) to potential equipment repositories in the Vernon/Commerce warehousing district.

Additionally, the **USC Bus Yard** is in a good location to support charging for a small LA28 Operations fleet, given its ideal location adjacent to the Downtown Sports Park; spurring an infrastructure development here will also be the exact kind of investment that can benefit students long after the Game by advancing USC's bus electrification timeline.

There is a pressing need to accelerate charging infrastructure deployments for MDHD goods movement in the Los Angeles region to meet state fleet transition requirements. Vehicles from drayage trucks serving the Ports of Los Angeles and Long Beach to cargo vans operated by larger delivery companies will all need to rapidly electrify over the next 10 years to meet the state's deployment and climate targets. TEP's own goals are for 40% of drayage trucks to be zero emission and 60% of medium-duty trucks to be battery-electric by 2028. Over the past few years, LACI has worked on research projects to quantify just how much charging infrastructure the region needs to reach these targets, with the goal of catalyzing further investment prior to 2028.

In LACI's *Investment Blueprint for Heavy-Duty Charging to Support Battery-Electric Drayage along the I-710 Corridor* (710 Blueprint), we found that Los Angeles County alone will require 755 chargers to support just drayage trucks. Since completion of that Blueprint, LACI has secured over $15M in funding for three facilities in the I-710 Corridor that will combine to host over 100 chargers. Additional projects in LA County completed (or close to completed) from **Infrastructure-as-a-Service companies** such as TEP Partner Voltera Power, Forum

Mobility, Prologis Mobility, WattEV, and Zeem Solutions are advancing the region to this milestone, supporting both medium and heavy-duty trucks in some cases. Additionally, many of these companies have a presence in the Inland Empire as well, which provides an attractive opportunity for storing equipment given the comparative less expensive storage costs, though range requirements would increase with base facilities less central. This setup would work well for vehicles making one or two round-trips per day on a defined basis though.

For LA28's purposes, arranging an agreement with an infrastructure provider (whether for itself or for its contractors) to utilize this infrastructure during certain windows will provide a baseline of charger access for any MDHD BEVs in the fleet. These entities will already have existing subscribers to use the infrastructure, but by staggering charging schedules, the companies can maximize utilization while unlocking electrification for LA28. Under the right circumstances, LA28 can leverage this tailor-made MDHD infrastructure for its operation. This is simultaneously a great opportunity to grow these companies and catalyze even more investment in MDHD infrastructure to make deploying battery electric vehicles even easier for LA28 and its contractors.

It should be noted that, though the federal government has greatly supported the electrification of goods movement through tax credits and funding programs laid out in the Inflation Reduction Act and the Investment in Infrastructure and Jobs Act, this is only part of the required capital stack for these projects, and sustained state funding is necessary for progress to continue in California. Programs such LCFS, EnergIIZE, and SCE Charge Ready Transport can all help as Los Angeles grows its goods movement electrification infrastructure.

CHAPTER: 5 Next Steps

Implementation

In most cases, the above recommendations for permanent infrastructure investment are part of long-term transition plans by regulated agencies and districts. However, there are some cases where the agencies and districts had not previously planned for a 2028 timeline based on available funding, technological fit, or internal capacity. For instance, many of the transit agencies' initial ZEB plans are from 2020/2021 and require updates, and most school districts have not yet developed a comprehensive transition plan, opting for pilot programs over the past few years. There is now an opportunity to develop or update those plans and move aggressively over the next four years, given the funding available at the local, state, and federal levels, the need to build a foundation for the future green economy, and the support from communities and stakeholders to move further, faster, together.

Using the 2028 Games as a rallying point before which to deploy the permanent zero emission charging infrastructure will pull forward the local and regional economic activity that can benefit working Angelenos today in many ways. Advancing these economic benefits to the immediate future is important to the region's long-term supply chain competitiveness, while projects of the scope proposed can create hundreds of jobs through zero emissions infrastructure equipment installation and maintenance. Expanding the ongoing roster of infrastructure projects further improves California's growing supply chain ecosystem of EVs and associated charging equipment. The considerations for how innovative approaches to provisioning charging and energy can also create opportunities for startups to implement their products and services, as these technologies continue to grow their presence in the zero-emission transportation ecosystem. LACI is committed to further building a diverse portfolio of transportation and energy companies over the next four years, incubating companies that can even provide solutions to challenges not yet known. By prioritizing as many investments as possible before the 2028 Games, the region can sustain acceleration of transportation electrification to drive economic growth in California in the years following.

LA28 is focused on hosting a Games that leverages the best of what Southern California already has to offer. This central tenet provides the impetus to execute investments over the next few years that will show Los Angeles is ahead of schedule on its zero emissions transition and provide a model for other cities to replicate. Part of this replication framework is to ensure the region's investments are sustainable; thus, a crucial aspect of engagement is to share the resulting Blueprint with financial institutions, energy service providers or infrastructure groups. For projects where private capital serves a financing purpose, there is a near-term opportunity to leverage the US Environmental Protection Agency Greenhouse Gas Reduction Fund, distributed to Community Development Financial Institutions to provide low-cost debt for projects that advance climate goals. Where possible, LACI and other regional stakeholders should seek to leverage this low-cost capital for the applicable transportation electrification

projects, a process LACI is already undertaking. Seeking financial institutions' participation in implementation will be necessary to ensure the financial sustainability of Los Angeles' zero emission transportation systems displayed during the 2028 Games.

This effort has also developed a framework for solving the challenges a transportation authority and city faces in deploying MDHD zero emission vehicles to support the increased transportation needs associated with large, prolonged events such as the 2028 Games. Los Angeles even could test the Off-Grid depot concept or the maximization of transit throughput during the World Cup in 2026. Smaller, singular events, like concerts, that require moving spectators to an area typically underserved by transit, would also benefit from understanding how to ensure zero emission options can support these customized shuttle needs. The process includes identifying synergies between event transportation needs and existing infrastructure and deploying mobile assets to support any gaps in the operation. Additionally, LACI will leverage its national and international relationships and offer future Olympic and Paralympic cities this Blueprint for deploying charging infrastructure that supports zero emission vehicle operations while providing lasting benefits.

Community Engagement

LACI is committed to working with communities for the implementation of this Blueprint, not only to communicate the environmental benefits that will accrue to regions of the County often overlooked, but also to engage community members from an economic development perspective, both regarding the job creation and the business formation potential.

Accelerating the reduction of pollution and emissions in Disadvantaged Communities (DACs) is a key reason to catalyze this infrastructure in the near-term, as every year that the transition is delayed brings further harm to these communities. Many of the high-volume route's pass through, and venues and hubs are in these communities that have borne the brunt of pollution over the previous decades. Prioritizing investment that ensures increased zero emission transportation in and through these communities not only will demonstrate the depth of Los Angeles' commitment to these communities, but also will lay a foundation of clean transportation for these residents.

The 2028 Games presents a generational chance for economic benefits to reach small businesses across the region, but this will require a deliberate planning effort to ensure proper outreach and accessibility is made for companies to participate. LACI has consistently worked with local companies to prepare them for this moment. For instance, LACI's Founders Business Accelerator (FBA), an impact acceleration program, with support from the LA Mayor's Office of Economic Development, helps underrepresented, disadvantaged small business and startup founders in low-income neighborhoods across LA to grow their businesses and increase their community, social and environmental impact.

As part of our engagement and education strategy, we have hosted workshops and events to educate community stakeholders, including topics on current zero-emissions mobility and delivery solutions and models. As a result, our community partners and pilot participants have

reported feeling more comfortable using EVs, and some have expressed interest in integrating EVs into their operations. The more familiar local businesses are with the zero-emissions transportation ecosystem, the better prepared they will be to support LA28's zero emission needs. One example of this could be the operation of an Off-Grid depot. Cycling through the mobile energy assets, ensuring charging units are properly hooked up to the BESS, and troubleshooting any issues that arise are all valuable skills that can support LA28 while preparing the workforce for a battery-focused future.

From a job creation perspective, LACI will continue to advance opportunities for high-road green economy jobs, whether through engagement with local unions or implementation of tailored training programs. Through TEP, LACI works closely with the International Brotherhood of Electrical Workers Local 11 and the National Electrical Contractors Association, Los Angeles Chapter, to understand how to ingrain workforce development into any regional investments. Further, LACI's workforce development program, the Green Jobs Fellowship is specifically focused on creating pathways for underrepresented groups (average 90% BIPOC) to participate in the green economy. In fact, since LACI launched our workforce development initiative in spring 2019, it has exceeded expectations to bring unemployed and underemployed participants from underrepresented groups in the City and County of Los Angeles into the burgeoning cleantech workforce. Previous Green Jobs Fellowship Program Cohorts have focused on Prototyping, Design, Manufacturing, and EV Network Technician Training as well as EV Maintenance Training. To help implement this Blueprint's focus on MDHD EVs, LACI will continue to supply the requisite hands-on training to ensure that during and after the 2028 Games, the local workforce has the skills to maintain an expanded infrastructure and increase in MDHD mobility options across the city.

For LACI's workforce development efforts, external outreach and community engagement is critical to engage participants from disadvantaged communities throughout LA County. To broaden our outreach, LACI attends community-focused events and builds key partnerships with elected officials, community-based organizations, and workforce centers to disseminate information to their participants. LACI is especially focused on collaborating with partner organizations that provide services to veterans, disabled, justice impacted, high school graduates, matriculating college students, college graduates or incumbent workers seeking transition training.

GLOSSARY

ALTERNATING CURRENT (AC) -- Flow of electricity that constantly changes direction between positive and negative sides. Almost all power produced by electric utilities in the United States moves in current that shifts direction at a rate of 60 times per second.

BATTERY ELECTRIC VEHICLE (BEV) -- Also known as an "All-electric" vehicle (AEV), BEVs utilize energy that is stored in rechargeable battery packs. BEVs sustain their power through the batteries and therefore must be plugged into an external electricity source to recharge.

BESS – Battery energy storage system

CALIFORNIA AIR RESOURCES BOARD (ARB) -- The "clean air agency" in the government of California, whose main goals include attaining and maintaining healthy air quality; protecting the public from exposure to toxic air contaminants; and providing innovative approaches for complying with air pollution rules and regulations.

CALIFORNIA DEPARTMENT OF TRANSPORTATION (Caltrans) -- is responsible for the design, construction, maintenance, and operation of the California State Highway System, as well as that portion of the Interstate Highway System within the state's boundaries. CALIFORNIA ENERGY COMMISSION - The state's primary energy policy and planning agency. The agency was established by the California Legislature through the Warren-Alquist Act in 1974. It has seven core responsibilities:

- Developing renewable energy
- Transforming transportation
- Increasing energy efficiency
- Investing in energy innovation
- Advancing state energy policy
- Certifying thermal power plants
- Preparing for energy emergencies

CHARGE READY TRANSPORT PROGRAM -- An initiative by Southern California Edison to fund charging infrastructure for commercial electric vehicles, covering high-voltage equipment, conduit, and construction.

DIRECT CURRENT (DC) -- A charge of electricity that flows in one direction and is the type of power that comes from a battery.

ELECTRIC VEHICLE CHARGING STATION (EVSE) -- Infrastructure designed to supply power to EVs. EVSE can charge a wide variety of EVs including BEVs and PHEVs.4

ELECTRIC VEHICLES (EV) -- A broad category that includes all vehicles that are fully powered by Electricity or an Electric Motor.

EnergIIZE – An reimbursement-style infrastructure incentive block grant project funded by the California Energy Commission and implemented by CALSTART, Inc. which provides incentives for medium- and heavy-duty zero-emission vehicle infrastructure projects in California.

MEDIUM- AND HEAVY-DUTY (MDHD) -- Refers to medium-duty and heavy-duty vehicles, including larger trucks and buses, often prioritized in emissions reduction programs for their higher fuel use and impact.

LA28 -- The non-profit organizing committee of the 2028 Olympic and Paralympic Games

LEVEL 2 CHARGER (L2) -- A charger that typically provides 240 volts of AC electricity, faster than a standard household outlet and suitable for vehicles parked for extended periods.

DISADVANTAGED COMMUNITIES (DACs) -- Communities that experience higher pollution levels and socio-economic challenges, often prioritized for clean energy and infrastructure projects.

LACI -- Los Angeles Cleantech Incubator

LOS ANGELES DEPARTMENT OF TRANSPORTATION (LADOT) -- a municipal agency that oversees transportation planning, design, construction, maintenance and operations within the City of Los Angeles.

LOS ANGELES UNIFIED SCHOOL DISTRICT (LAUSD) -- Second largest in the nation, the Los Angeles Unified School District (LAUSD) serves over 600,000 students in kindergarten through twelfth grade at over 1,000 schools. The District also has over 200 independently-operated public charter schools, authorized by the Los Angeles Unified School District Board of Education.

LOW CARBON FUEL STANDARD (LCFS) -- A set of standards designed to encourage the use of cleaner low-carbon fuels in California, encourage the production of those fuels, and therefore, reduce greenhouse gas (GHG) emissions. The LCFS standards are expressed in terms of the "carbon intensity" (CI) of gasoline and diesel fuel and their respective substitutes. The LCFS is a key part of a comprehensive set of programs in California to cut greenhouse gas emission and other smog-forming and toxic air pollutants by improving vehicle technology, reducing fuel consumption, and increasing transportation mobility options.

MPA -- Media and priority attendees

OPEN CHARGE POINT PROTOCOL (OCPP) -- An open-source standard for communication between electric vehicle chargers and management software, allowing compatibility across different systems.

RFI – Request for Information

S/W -- Spector/Workforce

TEP -- Transportation Electrification Partnership

ZERO-EMISSION BUS (ZEB) -- A bus that operates without emitting exhaust pollutants, often electric or hydrogen-fueled.

ZERO-EMISSION VEHICLE (ZEV) -- Vehicles which produce no emissions from the on-board source of power (e.g., an electric vehicle).

APPENDIX A:
Webinar Participation Statistics

Webinar Participation Statistics

Statistics:	Count
Questions received during webinar Q&A session	26
Questions received via email	33
RFI and Webinar Invitation Emails sent by GNA	353
RFI and Webinar Invitation Emails sent by LACI	353
Webinar attendees	89

Application Statistics

Statistics:	Count
Total number of RFI submissions	24
Responses to Option A (Mobile and Modular Charging Infrastructure)	12
Responses to Option B (Electric Mobility Solutions)	6
Responses to Option C (Option A & B)	6
Application submissions from companies with California headquarters or office	17
Application submissions from companies with Los Angeles County headquarters or office	10
Applications in progress (not submitted)	32
Median years of operation for applicants	5
Average years of operation for applicants	8.5

Questions received during webinar Q&A session	26
Questions received via email	33
RFI and Webinar Invitation Emails sent by GNA	353
RFI and Webinar Invitation Emails sent by LACI	353
Webinar attendees	89